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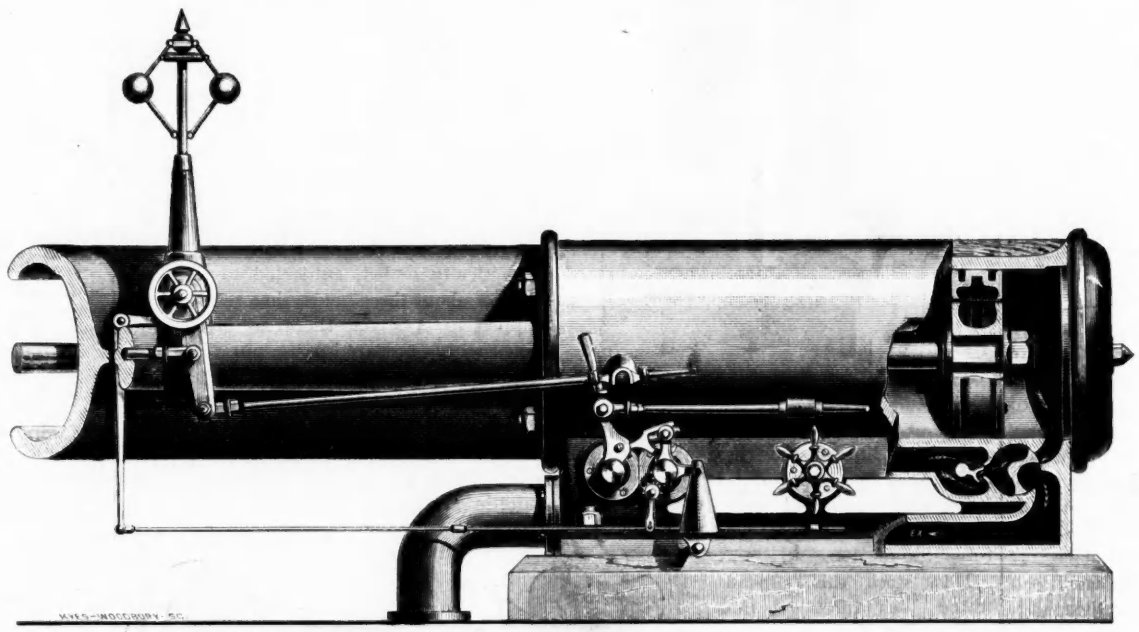
The Wheelock Engine.

The economy of variable or automatic cut-off engines has been so well established, that no remarks in favor of the general system are required. To overcome the objection of complication for common use is a desideratum well attained in the machine herewith shown.

By reducing the number of parts and placing all the mechanism for operating the valves on the outside of the steam chest, every defect may be at once detected.

Valves are used, which are suspended on hardened steel trunnions, or stems, and hardened steel bushings, and are located directly under the bore of the cylinder at each end, thereby reducing the clearance to the smallest possible amount. The valves and seats are made tapering in their general diameter, and the pressure of steam comes on one side, which also acts to keep the collar in contact with the sleeve (see Figs. 4 and 5, on page 2.) Steam is admitted and exhausted by a single valve, and any variation of the load is at once communicated through the action of the governor, which has entire control over two cut-off valves, or wipers, by a simple mechanism, the construction of which is such as to insure entire uniformity of speed under extreme variation of load. A cavity in face of the cut-off valves allows a double admission and closing. A very perfect result is claimed as due to the fact, that the valves are suspended on the hardened steel trunnions and bushings, thereby maintaining the valve in a central position. Attention is called to the fact, that the cut-off does not control the time of admission or lead to the cylinder, but is well open before the main valve is ready to open the induction port. This is claimed as a great advantage, especially where steam follows but a small portion of the stroke. The explanation is, that, if the cut-off opens but a crack, as in cases where the lead is controlled by the cut-off, the mechanism is not sufficient to close it, and steam sizzles through during the whole stroke, thereby making speed irregular. The valve gear is constructed in the simplest form of the ordinary eccentric rod, and is made to disengage at the pleasure of the engineer, by which result the engine can be worked by hand, either forward or backward, with perfect ease, a point very desirable in practice.

By reference to the cuts on this page, showing valve gear, it will be noticed that the cut-off is worked from main valve crank. The pin being an eccentric bolt makes adjustment very handy. This attachment produces the celebrated wrist-plate motion, without its complications.



CYLINDER AND VALVE GEAR.

The entire adjustability of the valves to their seats is secured by a peculiar arrangement of the steel bushings (which can be driven in or out as required), the inner end forming a joint against the steel valve stem or trunnion, entirely obviating the necessity of any stuffing box. These steel stems have been found in practice to wear endwise, in about equal ratio with the surface of the valves and their seats, and as the valves are suspended, with the surfaces in but slight contact, while the pressure inclines the valves to their seats, great durability is obtained. The steam chest is located underneath and forms a part of the cylinder, as is also the exhaust passage. The latter is entirely separated from the steam chest, and in no way influences the live steam, while easily disposing of any accumulation of water.

The cylinder has but two ports, and the valves being suspended do not gouge out the seats, nor do the seats need to be recessed. The object of this construction is to get the effect of steam balancing without the objections that apply to that method.

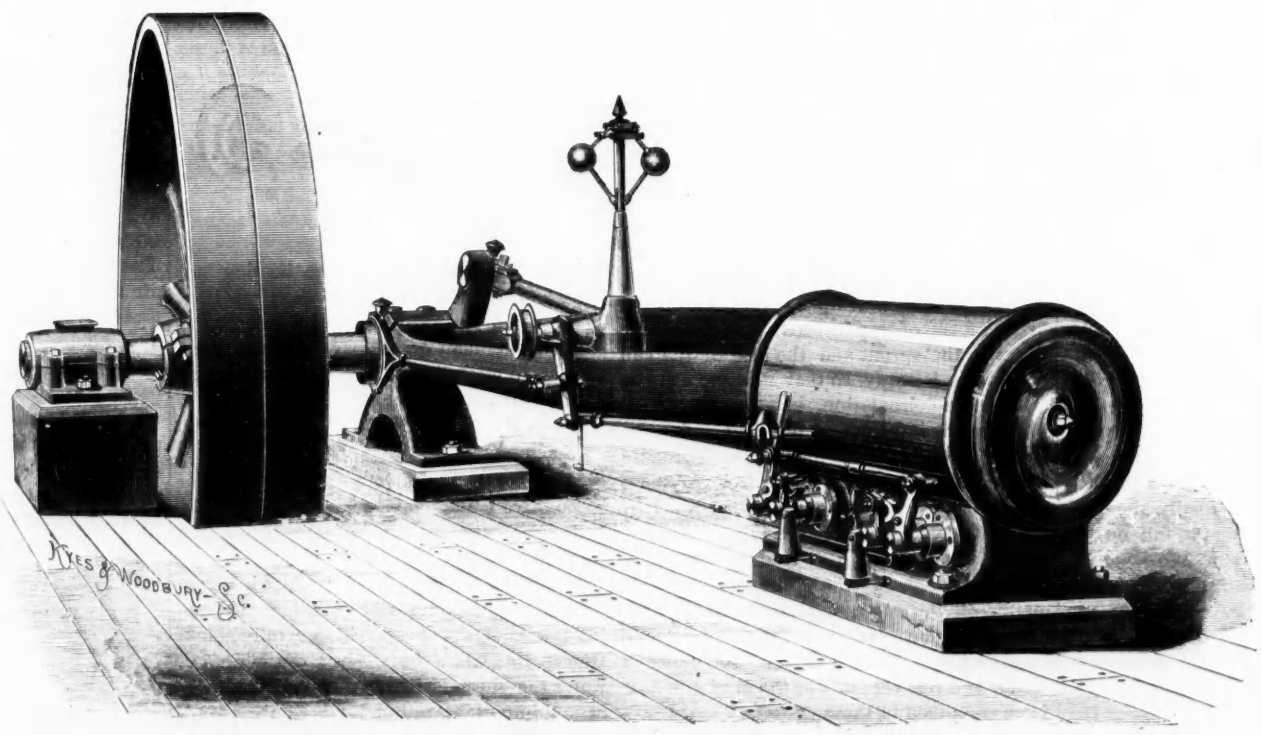
In the production of the Wheelock engine it has been the aim of the manufacturer to produce an engine with the most advantages, and the fewest disadvantages, to be found in any machine now offered to the public. His success in that direction may be measured by the high position the engine has attained, where it is known.

The arrangement of the valves not only reduces the clearance to a minimum, but guards against a waste of steam through exhaust port, if there be a leakage in the cut-off valve.

The cylinders of these engines are fitted with the Wheelock piston and steam packing, which have shown gratifying results in use during sixteen years.

The stop motion in use in these engines effectually prevents the engine from running too fast, in case of accident to the governor.

Another good point is found in the improved throttle valve just brought out. By a glance at the cut (Fig. 3) it will be seen that the steam is always on the side to press the valve to its seat. The stem is provided with a collar, which comes in contact with the inner shoulder of the bonnet, obviating the need of a stuffing box. As the screw is made to push the valve from its seat, it forces the collar against the shoulder, and makes a tight joint and swivel valve, without the objections of rattling when partly shut; the pressure on both valve and its stem being always toward the atmosphere.



THE WHEELOCK ENGINE.

At the American Institute Fair in 1875 the Wheelock engine received the award of the gold medal of progress. It was exhibited at the Centennial Exposition, and received a medal and diploma, together with much favorable notice from engineers from all parts of the world. At the International Exposition in Paris, 1878, the Wheelock engine received the grand prize; and at the Millers' Exposition, Cincinnati, in June, 1880, it went into the test with other first-class engines, and has just been awarded the splendid gold medal and diploma, valued at $500. These engines are manufactured at the Wheelock Steam Engine Works, Worcester, Mass.

In using low exhaust nozzles upon locomotives, it is necessary to renew the bottom boiler tubes every eight months, while with high nozzles they last one year.

Apprentice Papers.

BY CHORDAL.

VII.

THE SOURCE OF FORCE.

As stated in the previous chapter, Force is a mystery to us. But it is an interesting mystery, and there is a pleasure in an inquiry and speculation concerning it. We understand the action of force, its laws of application and measurement. Every operation of the mechanic, in fact every motion made by man, is based on some knowledge of the laws of force. It is merely a matter of interest to look into the source of force and see where it comes from and how it comes. We can do this with some satisfaction, but still we do not know what it is or what starts it into existence.

We will find that almost every force is the result of the action of heat, and we will find that almost every force is not only due to heat, but that it is due to the heat of the sun. It is hard to imagine a motion made by anything on earth which we cannot trace back directly to the sun's heat.

We speak familiarly of water power, steam power and animal power. Let us look into these matters.

We get water power from water wheels run by water. A water wheel is inert matter, and will never run itself. Water is inert matter, and will never move of its own accord. But if we can find water high enough up to give some fall, we can let it fall on a water wheel and thus get motion and power. The water is pulled down by gravity; it does not pull itself down. Before water can fall downward it must get upward in some way. We find a river like Niagara in which water continually flows from a high level to a low one. Here is the motion of falling water; here is power; here we may put water wheels and get useful power. There are thousands of little Niagaras all over the earth. Wherever a stream runs down hill we may put a dam and concentrate a great deal of the fall at one place. If we could see all over the earth at one broad view we would see thousands upon thousands of waterfalls, some turning water wheels and some doing nothing. We would see that some water was high up, and that gravity was drawing it downward closer to the earth. Sometimes it falls abruptly at a waterfall; sometimes gradually, as in flowing rivers. As we take this broad view of falling waters on the earth, we might wonder how long it will be before all the water falls down so these waterfalls and rivers will stop. We can see that it might happen in a day or two. We might see that there are streams enough to carry all the waters of the earth to the low levels in a few days. But we do see that the flow is continuous, that the rivers do not stop, and that by some means the water gets up again to the high places.

If we watch closely, we will find that the upper levels are being constantly supplied with water from the clouds. The rains and snows deposit water as fast as it flows away. If we watch the low places we find that, instead of getting full and overflowing, they keep about the same, notwithstanding the immense quantities of water flowing into them. We find that the sun heats the surface of the water, and that delicate vapors, lighter than the air, rise and form clouds. These clouds get denser and heavier as they float over high places, and finally they become heavier than the air and fall on the earth in the form of rain or snow. This water forms rivers and streams, and is drawn by gravity to lower levels, where the sun evaporates it again; and so it keeps on its perpetual round. If the sun did not evaporate the low waters there would be no rain, no water on the high levels, no flowing streams, no waterfalls, no water power. The high levels would be dry, and the low levels would accumulate all the waters of the earth.

If we put a cold, empty locomotive on a railroad, we cannot get it to move itself. It is inert matter. We put water into the boiler, and still cannot get the engine to move. There is no force in water; it is inert matter. We put coal under the boiler, and no change takes place. There is no power in coal; it is inert matter. But if we set the coal on fire we have heat. The heat expands the water into steam, and the continual expansion of this water into steam will press on the piston of the engine and give us motion.

Here it will be seen that we do not get power out of the engine, or the boiler, or the

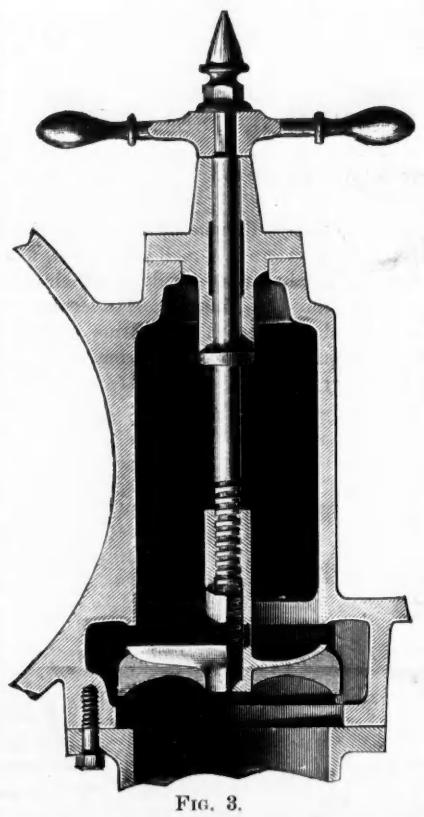


FIG. 3.

water, or the coal, but out of the heat in the coal. We liberate this heat and turn the heat force into motion. Our engine and boiler and water and coal are simply inert matter, which we use to convert the heat force into motion.

How does this concentrated heat force get into coal? By the action, on certain substances, of heat, which produces decay and chemical changes generally. Coal is composed of decayed vegetable and animal matter, on which the heat of the sun has acted for ages. The earth absorbs heat from the sun, and these matters, which get buried under the crust of the earth, decay and go through chemical changes that turn them into combinations of heat-absorbing and heat-producing elements which take the form of coal. If the sun gave no heat, the earth would be cold; there would be no decay of animal or vegetable matter, and there would be no coal.

Wood and all other substances which will burn and give out heat, owe their existence to the heat of the sun. The delicate seed put into the warm earth changes its structure, expands and throws up a sprout. Moisture in the form of sap creeps up through the fibers of the sprout and the heat of the sun evaporates it away, so that new sap can rise and keep up circulation.

Under the influence of the heat action the sprout absorbs new matter, and finally reaches the bulk of the forest tree. We cut the tree and recover from its wood much of the heat force it has been receiving for years. If the sun gave no heat seeds would never sprout, and there would be no vegetable matter on the earth and no vegetable fuel. Our steam power comes from the sun. We may burn wood, or corn, or oats under a boiler, and recover and use much of the heat force contained in these matters.

We also find that the animal system gives us a means of utilizing the heat forces in many substances. Instead of burning the corn or oats we feed them to horses and cattle. The corn or oats decompose and decay, and the heat force, by some means unknown, becomes stored in the muscles. The muscles give us force and motion and power so long as we keep up the supply of heat-containing food. If we stop the feeding, the animal loses force and grows weak. If the system gets out of order so as not to convert the forces properly, the animal grows weak and dies. So long as the proper heat food is supplied and the system is in order, the muscles will yield a large percentage of the heat stored in the food, precisely as an engine will give us power if it is in running order and kept supplied with fuel.

If the sun failed to give its heat to substances which men and other animals could eat, there would be no animal force, no animal motion, no animal life. When we lift a hand or a foot, we expend force received in a roundabout way from the sun.

Experiments have been made by Clinton M. Ball of this city, and an efficient electrician, which, if successful in practical application, will revolutionize, to a certain extent, the burning of carbon in electric lights. The substance used in manufacturing buttons by a Hoosick, N. Y., concern is vegetable ivory found in Brazil. The idea occurred to Mr. Ball that the waste ivory carbonized would excel retort carbon for use in electric lights, of which he is the inventor. Accordingly steps have been taken to produce carbon points from the refuse substance. Two hundred and forty-two sacks of ivory chippings, weighing 25,900 pounds, have been put through the initial stages at the works of the Troy gas company, and are now at Ansonia, Conn., being made into carbon points. The ivory was placed in a retort at the gas works, hermetically sealed, subjected to a cherry heat for about three hours, then resacked and shipped to Ansonia, there to be ground, mixed with a prepared paste, put under hydraulic pressure and made into carbon sticks. It is claimed that preliminary experiments have proved that a better light can be obtained from the carbonized ivory than from retort carbon, and that it is free from noxious metallic and other mixtures.—Troy *Daily Times*.

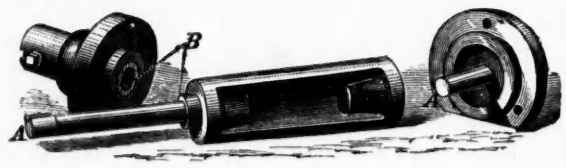


FIG. 4.

A few years ago 30 miles per hour with light trains was considered a high speed upon railroads. Now 60 miles per hour is required, and a speed rating at seventy-five miles per hour has been run for short distances. To accomplish this requires larger

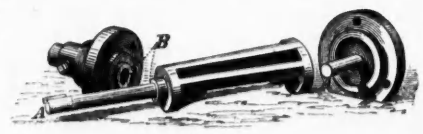


FIG. 5.

boilers, larger cylinders, more heating surface, and, in fact, revolutionizes railroading. It necessitates careful study and a display of skillful judgment on the part of master mechanics to master these new problems, which are daily demanding more attention.

Care of Steel Boilers.

Steel has been tried in numerous cases for locomotive boilers, and abandoned by some, because of the cracking of the sheets that form the fire box.

If a boiler having a steel fire box is blown off and washed with cold water before allowing it to cool, the sheets will generally crack. But if the boiler be washed out with hot water the sheets will not crack. We know of an important railroad where they were constantly troubled by cracked steel boilers while pursuing the former plan, but since adopting the latter, not a single sheet has cracked. It is also an excellent method to bank the fires, and not let them go out, unless it is necessary to do work upon the boilers.

The boilers are thus kept free from the damaging and dangerous results occasioned by great and frequent changes of temperature.

Need of a Standard for Apprentices.

The following extract from a letter of our esteemed contributor, Frank H. Richards, is suggestive of an improvement in the manner of dealing with the apprentice question. We believe with him, that it is, to say the least, not business-like to expect to keep up the standard of our machine shops by trying to make good journeymen from ignorant, inapt apprentices; and, that, as suggested by him, machine shop managers might do well to canvass the propriety of insisting upon some educational standard, by which to measure the fitness of young men to become apprentices in the shops under their control. We commend his views to the consideration of our readers.

Why don't machinists know more of arithmetic? Why don't we inquire into the previous schooling of the boys we take into our shops, and insist upon a certain amount of it as a necessary qualification? Is it any wonder that apprentices are in disfavor? How long could a shop be run successfully if no more judgment was exercised in the selection of workmen than in the admission of apprentices? Suppose we hired every tramp that came along until the shop was full, and never weeded them out. We don't usually get even the average boy for an apprentice. Too often the reason the father assigns for trying to get his boy into the shop, is that he won't go to school. In such cases the answer should be: "Why, my dear sir, then we don't want him. We wouldn't hurt your feelings for the world, but there is either ignorance or impudence behind your proposition."

A machinist in our day is as well equipped without tools as without education. Many and worthy of all honor are they who have realized their needs after entering the trade, and made their best efforts to supply them. No one is fit to begin as a machinist until he is familiar with figures, and has a good general knowledge of the mechanical powers and the physical properties of matter. An inaptitude for such studies should warrant a strong presumption of inaptitude for mechanical pursuits. How often in the shop I am annoyed to see experienced mechanics strapping work to a machine, and so applying bolts and blocks as to evince their total ignorance of the principle of the lever.

The British troops were lately surprised to find the Boers of South Africa the best marksmen in the world; and the reason assigned for their excellence is that the dry soil raises a dust and shows where every shot strikes, and their aim and judgment are thus continually corrected. So a familiarity with figures is to the judgment of the machinist a constant test and corrective in all the questions which arise of relative sizes, strengths, speeds, strains, etc., and in the end the superiority of him who knows, over him who guesses, is indisputable.

For example, the arithmetical rule of simple proportion which is used in screw cutting is of hourly and almost universal application in the shop, and skill in applying it is not the less necessary because some live without it, just as men have lived without an arm or a leg.

Cast Iron Lathe Tools.

One of the most interesting things in the tool line, noticed by us in a recent visit to the Pennsylvania Railroad machine shops at Altoona, was the use of cast iron lathe tools. We saw one tool which had been used to face off four cylinder heads without grinding. The workmen do this work by the piece, and are allowed to choose either steel or cast iron tools, and they prefer the cast iron tools. The whole secret of the success of cast iron tools lies in the use of proper iron, and in getting a good chill in casting. The iron used in this case is the same as that used for car wheels, and takes a good chill. These tools are also used for planing hard cast iron, and are found to stand where the edge would be burned off a steel tool. They are also used for turning and planing wrought iron and steel.

It is considered bad practice to make the bottom of stuffing boxes or glands flat, as, when the gland presses upon the packing, it has a tendency to flatten it, rather than close it tightly about the rod. The bottoms of all stuffing boxes and glands where fibrous packing is used should be of a conical shape, in order to close the packing around the rod with the least possible pressure.

Oakum is represented as a good and cheap material for filling wheels used in transmitting power by wire rope.

The Standish Foot-Power Hammer.

The machine herewith illustrated is designed for forging light work, and is said to be specially adapted to weld small pieces that it is difficult to weld by hand, such as all descriptions of carriage irons, etc. By reference to the engraving, it will be seen that the column, which is adapted to have fastened to it all the working parts of the machine, ends in a square base to insure the necessary stability. The hammer casting weighs 85 lbs., and the stroke, which can be regulated at will, determines the weight of the blow. The dies, which are of cast iron, cast steel or forged steel, according to the quality of the work to be done, will be, when it is desired, furnished by the manufacturer, and of any form required. The engraving so clearly shows the characteristic features of the machine as to render a detailed description of its parts unnecessary.

S. A. Smith, 42 Dey St., New York, and 154 Lake St., Chicago, Ill., is agent for the sale of these machines.

The Secretary of the American Iron and Steel Association in his forthcoming annual report, places the production of pig iron in 1880 at 4,295,414 tons, an advance of over 40 per cent. above the previous year. Bessemer Ingots reached 1,461,837 tons, an advance of about 60 per cent. over 1879. Much of this material went into rails, the figures being 954,460 tons, an advance of about 40 per cent. over the year 1879. The product of open hearth steel doubled in 1880, being 112,953 tons. Crucible steel increased about 27 per cent., reaching 72,424 tons. Rolled iron, including nails, figures 1,838,906 tons, an advance of nearly 15 per cent. Iron rails figure 493,762 tons, an advance of over 20 per cent.

Shop Kinks.

No. 13.

DEVICE FOR RAISING AND LOWERING PLANER CROSS HEADS.

By L. F. Lyne.

In most shops where iron planers are used, the method employed for raising and lowering the cross heads is by means of a crank applied to the square end of the cross shaft at the top of the machine.

This method is all very well so long as a workman can operate the crank conveniently by standing upon the floor. But to accomplish the desired object upon larger planers the workman has to climb upon a step ladder or box, and, when the box is required, it will generally be found that some one has appropriated the same, and has it fast in some place where it cannot be removed at once.

A person occupying an awkward position, as in standing upon a box or ladder, cannot easily perform the work of turning the crank, particularly when the cross head moves hard. A very handy application for raising and lowering the cross head has been used for some years upon planers of various sizes. It consists of one tight and two loose pulleys attached to the cross shaft referred to at the top of the planer. A straight belt and cross belt communicates motion from a counter shaft, so that by throwing a shifter the cross head may be raised or lowered.

This is a very good device for large planers, where the cross head is heavy and moves exceedingly hard. But upon medium sized planers it is generally customary to run off the belts when not in use, to prevent unnecessary wear of the parts. For raising or lowering the cross head short distances, it is a loss of time and a great inconvenience to get a ladder to climb up and put the belts on the pulleys. This arrangement is often the cause of accident to the planer. For instance, suppose the workman forgets to loosen all the bolts that hold the cross head before starting the screws to raise or lower; the result will be that something will be badly strained or broken; whereas, if he raised or lowered by hand, the difficulty would be observed at once and remedied.

A few years ago, in fitting up a new shop I had occasion to put in a 60″ Sellers' Screw Motion Planer. The only means provided for raising and lowering the cross head was the application of a crank 7″ in length to the square end upon the cross shaft shown at *C* in Fig. 1, of the accompanying engravings. This was a very tedious and difficult operation, and to remedy the difficulty I applied the device shown in Figs. 1 and 2. It consisted of two chain wheels 6″ in diameter, one of which, *D*, was attached to the square end of the shaft *C*, supported by a bracket bolted to the top of the planer *J*. The other chain wheel *E* was bored out, and a boss upon the crank *H* turned to fit it, and keyed fast. The wheel and crank were supported upon a pin driven into a cast iron bracket *I*, bolted to the side piece or upright *A*, of the planer. The chain used, *G*, was what is known as the flat link, cut out of sheet iron ⅛″ thick. The links were one inch long, and to give the chain the required tension, the holes through the bracket, *I*, were slotted holes so that it could be moved slightly.

The Standish Foot Power Hammer.

The crank *H* was 12″ long, so that the workman could quickly raise and lower the heavy cross head *B* with the greatest ease, and using only one hand. To prevent the end of the shaft *C* from being strained, a block of metal, *F*, was bored to fit the same, and faced off to a sufficient height to fill the space between the shaft and the hub of the gear, upon the end of the screw. The screw was removed and a hole drilled in the end of it, to admit a tit turned upon the bottom of the block *F*, which held the block in its place.

This device may have been used before, but I never saw one like it, and therefore publish the same herewith for the benefit of those who may wish to use it.

The advantages of this device are that it is always ready for use, and is easy to operate, as the workman stands upon the floor for that purpose; the crank *H* being located at a proper height to be turned easily. It is also a very cheap affair, considering the benefits to be derived from its use, as a workman can, with its assistance, change the cross head in much less time than it usually takes to find a box or ladder to stand upon.

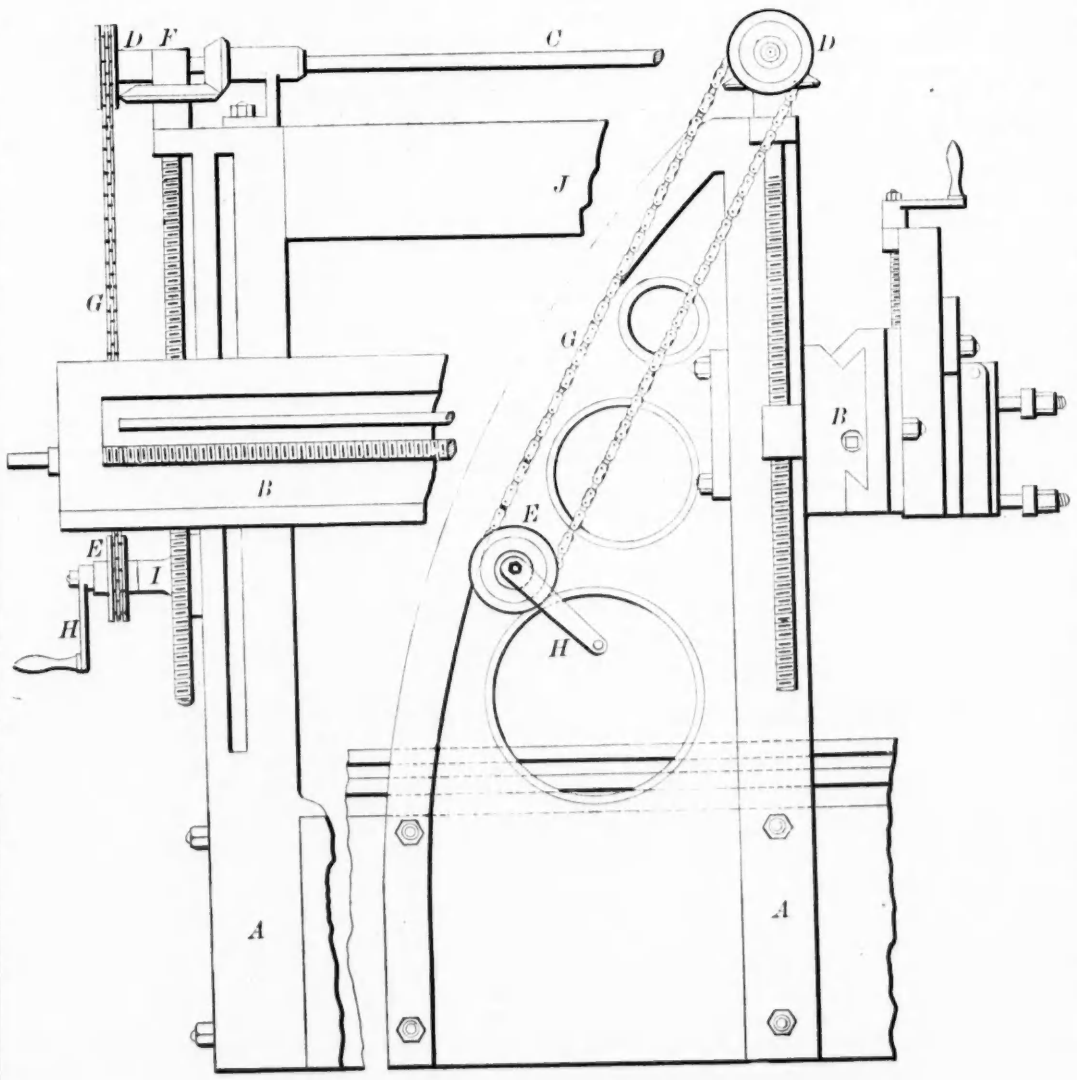


Fig. 1. *Fig. 2.*

Device for Raising and Lowering Planer Cross Heads.

A Double Cause for Detention.

A train report was sent to the general offices of one of our leading railroads, a short time since, stating that an express train lost a stated amount of time between the two terminal points. Ten minutes was lost through a red flag and twenty minutes through the breaking of a coupling.

It seems that a tramp, seated upon the platform of a baggage car, lost his hat, when he immediately arose and vigorously pulled the bell cord. The engineer promptly obeyed the signal and stopped the train, whereupon the tramp stepped from the train and walked back for his hat. When the conductor remonstrated with him, he said that his only hat had blown off, and he had no means of getting another; so he took the most available means open to him.

The only means of redress left for the railroad company was to start on their train, which they did so suddenly that the coupling broke, causing the unnecessary delay. The sequel does not say whether the tramp, after picking up his hat, resumed his position upon the platform of the baggage car or not.

A writer in the *American Miller* suggests that machines in which dust-producing material is briskly agitated, be kept in hermetically closed places; while bins and spouts, through which grain moves constantly, should be of iron, to lessen the danger of fire arising from the explosion of dust. The same writer also suggests that in building a mill, instead of laying the wooden beams at certain distances, it would be better to put them as closely together as possible, so that they will offer greater resistance to fire, or they might be partly of iron and partly of wood. It would not be advisable to have all the beams in a floor of iron, as they would get heated and break with the burden of pressure upon them.

Mr. Wm. Beetson, in 1840, used flexible leather caps for packing the water rods of pumps, in place of the ordinary stuffing box. There was an open space between the discs to be filled with fluid. In 1842 the same gentleman used a hollow leather bush with packing at each end, having a space between for lubricant.

Careful experiments with locomotives have proved that a brick arch in the fire box, as well as a baffle plate within the smoke box, are both very economical appliances. They save coal and prevent throwing fire. It has also been found by experiment upon one of our leading railroads, that 54 per cent. of the heat produced by combustion, is put directly into the boiler, and can be accounted for.

How is it that the "superheating" men do not tell us what temperature of steam their superheaters will give with any stated coal consumption? An investigation in this direction is apt to increase not only the efficiency of the "superheater," but to make it possible to keep up a higher temperature of steam at greater distances from the superheater than at present.

Epicycloidal Cutter for the Teeth of Gear Wheels.

The accompanying engraving represents an epicycloidal cutter for the teeth of gear wheels, recently introduced by the Brown & Sharpe Mfg. Co., of Providence, R. I.

As is well known, gears with this form of tooth, should be cut to the proper depth with great accuracy. In the cutter here shown, this is provided for by forming a shoulder, as clearly seen in the engraving, the shoulder constituting a gauge, which, as it cannot be changed, is always reliable. In use, it is only necessary to cut the depth to bring this shoulder to the face of the blank, and since, for obvious reasons, no deeper cut can be made, it follows there is no possibility of making a mistake, which is always liable to happen where the depth of tooth has to be measured on each gear cut. Another feature is that on the face of two teeth of the cutter a fine center line is made, which enables the operator to set the cutter exactly central with the spindle of the machine, thus insuring accurate work.

These cutters are made for either circular or diametrical pitch, and the rules and formulas for finding the diameters of blanks are the same as for the Brown & Sharpe system of involute teeth. These cutters have the same general features of the involute cutters made by this firm; that is, they may be sharpened on the face without in the least affecting the form or clearance of their cutting teeth. They also have the merit of being scientifically accurate in shape, and gears cut by them may be safely taken as having teeth which represent the best practice.

Mechanical Cranks.

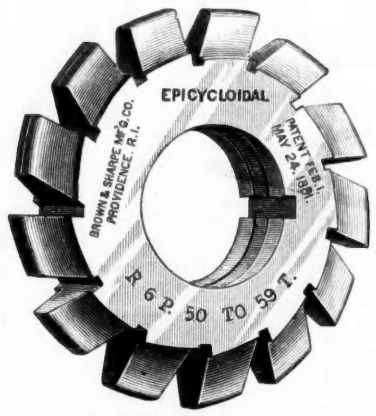
BY F. F. HEMENWAY.

The first distinctive representative of the class who propose—mechanically—to get something for nothing, was the man with the perpetual motion machine. This machine was always in a state of chronic incompleteness. Its possessor was addicted to tramping around, with the ultimate object of giving some one the privilege of making a fortune, by furnishing the necessary means for adding a couple of wheels, and readjusting the compound-double-acting-go-ahead-and-back-up lever; and in some way or another, he found a good many looking for fortunes. That machine was simply an effort to swindle nature; but its projector was by no means a swindler. He was a mechanical "crank." I don't take much stock in the average "crank;" men who let themselves loose with double-barreled shot guns and carving knives, intent on making some one miserable; or men who propose to cure all human maladies with exaggerated medicinal prescriptions; or who own unknown and unlimited railroads and unnumbered "corners." They are getting too numerous to be genuine; besides, they are too cranky. The genuine "crank" isn't cranky all over. The perpetual-motion mechanic was a genuine "crank." He was only cranky in one direction. When he was turned around he was all right, only he wouldn't stay reversed. The inclination of his cranky side was to the front.

There isn't much controversy in reference to perpetual motion now-a-days,—that is, not by its regular and constitutional name. There is everything in a name—sometimes.

Notwithstanding there isn't much of a boom in perpetual motion, the idea of playing to win against nature is too fascinating to be allowed to languish. If there is a good deal in a name sometimes, on the other hand it don't always matter what you call a thing. It is the intention that determines what it is.

There are just as many men to-day who believe in getting something for nothing, mechanically, as ever there were. The intention to outwit nature is always in order, and enthusiastic individuals will always be engaged in the enterprise. They don't call it perpetual motion, though. They don't hanker after the name. It is altogether too expressive. The result of this is, the original perpetual motion "crank" has got badly distanced. He was an honest "crank." I don't insinuate that this had anything to do with his coming out at the rear. The trouble with him was, there wasn't mystery enough about his ways and means to meet the requirements of the present time in that direction. His one or two insignificant little wheels, and a lever, which were always wanted to make things right, won't do for the enlightenment of the present day. His occupation is gone, and his place is filled by another, who is able to rise to the occasion. That other don't build little machines with a few gears and a couple of weights. He electrifies the world with



EPICYCLOIDAL CUTTER.

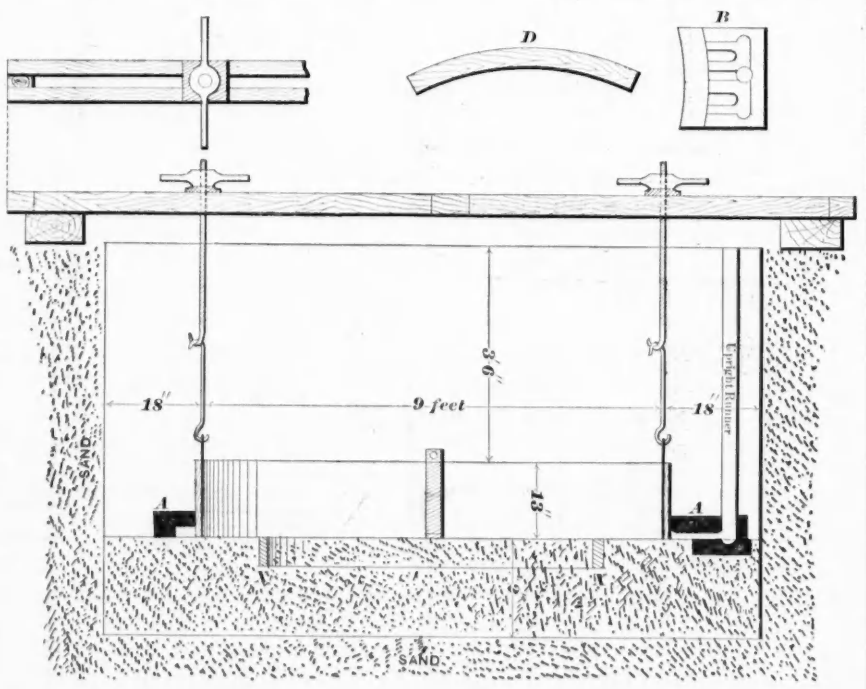
engines that turn big things for nothing—that is, they are going to turn them; and just as the world used to believe in the little perpetual motion "crank," and invest a few dollars to supply the missing link of the little machine it did see, so it believes in the big "crank," and invests a few thousand in the big machine it never sees. This is altogether according to sound theory.

It is generally admitted that there is a good deal in nature, and it looks childish to play for small stakes. What does it signify to cheat her into turning around a few little inconsequential shafts that ought to stand still, when she might be just as easily inveigled into turning millions of them. If we are to have mechanical "cranks," by all means let us have them of generous proportions; big enough to do credit to the trades. If we are after all, mistaken in our apprehension, and if some of the wonderful inventions, the very rumors of which liven up things, are machines with which to manufacture "cranks" from individuals with considerable money—and some brains, let us, by all means, have it done on a scale of respectable magnitude. Above all, don't let us call such things humbugs and swindles. It don't sound well, and it is old-fashioned. If we lose our money in trying to beat nature; or if we are short from assisting some one with the means of trying, there is a "crank" mixed up in the matter. Let us apply the legitimate name to the individual, and this will render unnecessary any harsh and unseemly characterization of the transaction.

Casting Large Pipes in Green Sand.

BY THOS. D. WEST.

The plan here described and shown for moulding large pipes or work of a similar nature, involves small expense, being in that respect far cheaper than loam moulds, especially when the oven is not large enough to dry the moulds, and they have to be dried on the floor. The foundry that made these pipes had an order for about a dozen, and they were wanted in a hurry. In the way shown there were three a week cast, and if there had been two pits there could have been one cast each day. The pipes weighed about 5,000 pounds each. Their diameter was nine feet, and their height five feet, and the thickness of metal one inch. There was a flange at the top and bottom by which to bolt them together. Elbow pipes that went with the plain ones were cast in loam, and, having worked on both jobs, I will give a description of how these were made when I get to loam work. In making the plain pipes there was a sheet iron curb sunk into the floor to prevent straining and to save work in digging and ramming. The draw pattern was made of wood, and was 18" deep, with four strong draw irons on it. In starting to mould it, a cast iron ring *X X* is set level, from which a level bed is made. This ring is never disturbed, so that the leveling by straight edges every time a casting is made is avoided. When the bed is finished, the draw pattern is set down and cores having the bottom flange formed in them, as shown at *A A*, are set around the pattern. There are two of these cores that the runner cores are attached to, as shown at *B*. These were set a quarter of a circle apart, and when all the cores were set, any open joints were packed with hemp so as to keep dust or dirt from getting to the flange. The facing and sand was shoveled in and rammed solid up to the level of the pattern, and then well vented. When all was ready, a man was placed at each screw handle. The cut only shows two screws and one beam; but as there are four draw irons needed, it takes four screws and two beams. At the word "Around!" each man turns his handle around once, doing this at every command. In this way the pattern is drawn even. This is a splendid rigging for drawing gears or anything that needs to be drawn level and steady. This pattern was drawn about five inches at a time until it was raised up level with the top of the curb, which made it the height required. The pattern was leveled at every drawing, and the vents carried up to the top by venting at every raising. After the cope was rammed up and taken off, the segment *D* was bedded all around the pattern to form the top flange. The upright runners were rammed up in the green sand, and had a core placed at the bottom to prevent any cutting. The ramming was tight towards the top, so that the iron would lie quiet, and to prevent any straining.



LETTERS FROM PRACTICAL MEN.

Standards of Measurement.

Editor American Machinist:

In your issue of July 16th, there is a letter from Mr. Jas. A. Taylor, Manager of Gauge Department, Betts Machine Company, asking for information as to the standard yard measure procured by the Pratt & Whitney Company for the purpose of establishing standards of measurement in their manufacture of tools for cutting screw threads. In reply to this, I beg to say that the difficulty of obtaining such standards was, I believe, well known by the company Mr. Taylor represents; for, if I mistake not, the Betts Machine Company had something to do with the examination of gauges procured about a year ago from several American makers of tools, who were supposed to have a standard of the English yard, or some of its subdivisions, and that in comparing the gauges submitted it was found that no two of them were exactly alike, and consequently no reliable selection could, under those circumstances, be made without further verification. Messrs. Pratt & Whitney undertook this task at great cost to themselves, and will undoubtedly accomplish the undertaking; if the Betts Machine Company will forward particulars of what they want to know to the Pratt & Whitney Company, I am sure that the latter will cheerfully give the required information.

JOHN ORTTON,
Gen'l Master Car Builder,
Canada Southern R. R.

St. Thomas, Ont.

The Ideal Engine.

Editor American Machinist:

In the face of all that has been said in your paper on the steam engine in general, with the many beautiful pictures and lucid explanations, and long rows of figures that never lie, it may seem presumptuously fastidious in a youngster like me to "ask for more," like Oliver.

When one builder put, as he said, the fly wheel in the cylinder, I wondered if the excessive weight would wear through the cylinder in a short time. I was also fearful of the surging effects of so much reciprocating metal. But he was ready to meet the latter objection with a heavy counter weight in the crank disk. In doing that, it looked to me as if he had merely hunted the fox to a new hole; and when I asked him how he counteracted the up and down surge at the main journal, and the consequent wear all on one side of the shaft, he was silent.

Another builder took the fly wheel out of the cylinder and put it in the cross head, so he could oil it better, and retained the counter weight.

Some builders make the reciprocating parts very heavy, so as to "maintain a uniform thrust on the crank pin," and then cushion heavily, so the thrust on the crank pin shall not be so uniform.

Others contend that considerable cushion is necessary to assist the balancing. How cushion will do that I cannot discern.

It looks to me as if cushion must react upon the cylinder heads, and surge the engine north and south just as vigorously as before.

Since high speeds have become so prevalent, the necessity of balancing all reciprocating, rotary and vibrating parts has been made uncomfortably apparent; so much so that an unbalanced wrist plate in the valve motion is a serious evil.

The ideal engine is to be balanced in all its moving parts. The power of the steam must be applied to the crank shaft with a purely torsional and steady force.

It seems to me that the engine could be balanced by observing the following rules:

Let all reciprocating parts be balanced by other reciprocating parts of equal weight or inertia, moving in the opposite direction.

Let all revolving parts be balanced by counterweights.

Let all vibratory parts be balanced by other vibrators in the opposite direction.

Let the "fling" of the connecting rod be met by the fling of another rod flinging the other way.

Then let the distribution of the steam be perfect, and its power applied to turn the shaft round, and not thrust it back and forth, and it looks as if we might have the Ideal Engine.

An engine which is balanced should undergo a test like this :

Take out both cylinder heads, slack up the main journal boxes, put a belt on the engine pulley, and drive it rapidly from some other power. If it runs still, it is balanced. If not, it is not balanced.

The ideal engine must stand a test as follows:

Suspend the engine in slings, slacken the main journals, put on steam and run it as fast as is safe without bursting the fly wheel, or flinging off the connecting rod.

Turn it horizontally, vertically and to all the angles between and if it will run without causing a tremor in the slings or its supports, it is all right, and, as before, if not, it is *not* right.

It will be seen by the above that the ideal engine must have no out-board bearing, but must be self contained.

APPRENTICE.

Ithaca, N. Y.

Annealing Steel.—Two Tailed Dogs.

Editor American Machinist:

I desire to state for Mr. Goodyear's information that the large piece of steel, referred to in my letter in the July 30th issue, was not touched by a blacksmith before annealing, as it was forged and cut off to order at the steel works, and the small pieces were only warmed enough to make them cut without fracturing, or flying to pieces. Regarding twist drills, I referred only to new, or nearly full length drills, and think, if Mr. Goodyear keeps an account of the breaks in any shop, he will agree with me.

Not finding any information or experience quoted by the readers of the AMERICAN MACHINIST, on the merits of the dog with two bent tails, I have had one made for 2-inch iron, and one for 2½-inch iron, and am more than satisfied with the result. I put the set screw through the root of one tail, and exactly opposite the other, and think it will drive with less twist on the screw, and hold better than if it was on the quarter. It also keeps the work balanced at high speed, and ordinarily does away with face plate drivers, which take time to adjust, and are not always to be found. No patent ; no royalty. No cards ; no cake. QUERIST.

Rochester, N. Y.

Drawing Room Matters.

Editor American Machinist:

One of your recent correspondents makes a good suggestion, that the steel-drafting triangles have "French curves" worked in them to lighten them, instead of circles, as proposed by Professor Sweet. By "French curves," I suppose, are meant lines of varying curvature, for ornaments and other irregular curved outlines. I would suggest that the logarithmic curve (see Fig. 1), be thus placed, as it is as useful as the ordinary fancy curve for mere irregular work, and comes in handy for drawing compound curves, for calculation, geometrical construction, &c.

I think it might be convenient to have a 45° triangle inside the 60,° as in Fig. 2. Another useful arrangement would be a series of slots of varying angles, as shown in Fig. 3, to facilitate drawing conventional screw threads of various pitches, &c. In my own work I use for these, hardwood trapezoids, which I make myself ; they come in very handy. See Fig. 4.

The average wooden triangle is a delusion and a snare ; and the framed ones are the very worst possible to get.

By the way, let me caution any one against buying T squares on faith. There is only one thing sold by dealers in draftsmen's materials that is more inaccurate, and that one thing is profile paper—whence many tears on the part of the subscriber.

I want to differ squarely with Professor Sweet as to "set ways or rules (conventional ways)" to make drawings. Every drawing should be understandable by every one interested, or likely to be interested therein. Then it will not require any "foolscap sheets of explanations," as referred to by Chordal.

ROBERT GRIMSHAW.

Safety Plugs that will Fuse—Boiler Explosions.

Editor American Machinist:

I do not quite agree with the writer of the article in No. 33, Vol. 4, of the *American*

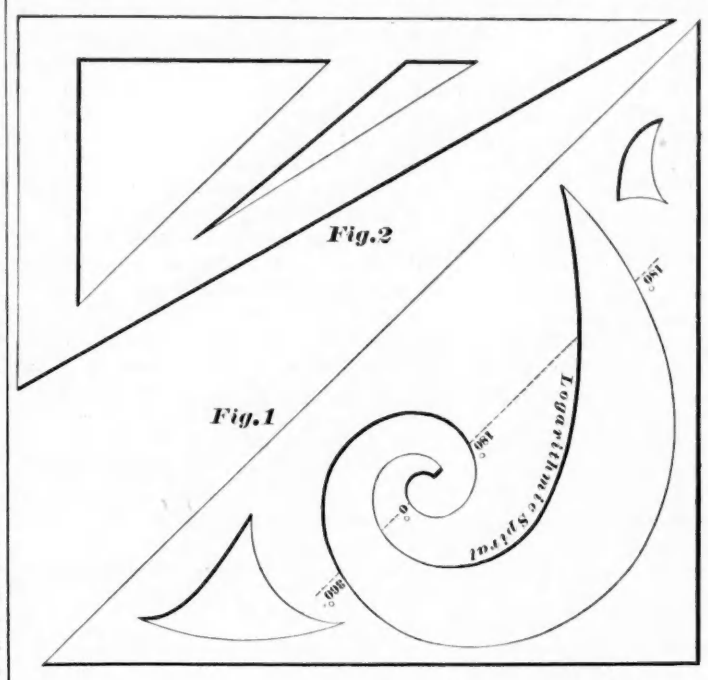


Fig. 1

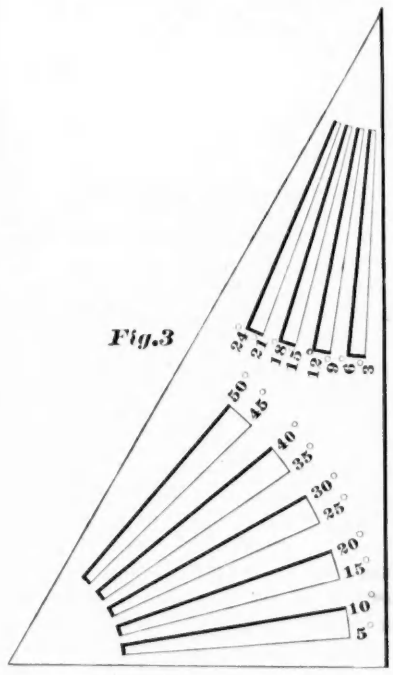


Fig. 3

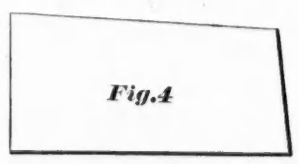


Fig. 4

Machinist about the utility of the safety plug for steam boilers. I do not claim that a safety plug is proof against all kinds of danger, but if the plug is properly made and put in the right place in a boiler it often saves the crown sheet from burning out. I had built about 300 portable boilers and engines without it, and was considerably annoyed about crown sheets burning out. I then used the safety plug, and have superintended the construction of about 1,500 engines and boilers since—up to a year ago, and have not had any trouble by the burning of crown sheets. At first it was difficult to get the metal to melt at the right temperature, but frequent trials solved that part. I run the plug up in the water about two inches; by so doing the dirt and lime does not cover the plug, besides it leaves plenty of water over the crown sheet.

Right here I wish to say a few words on boiler explosions. I am not much of a believer in the theory of low-water explosions, except that a continuance of low water weakens the boiler, and it of course gives out in the weakest place.

We hear so much of explosions occurring, and almost invariably it is stated that the steam was very low. This puts me in mind of an old acquaintance of mine who made axes. When a purchaser asked his guarantee, he would say that he made it a rule to warrant his axe in all wood but bass wood !

I had occasion to examine a steam gauge once, which was left upon the ground by reaction from a rocket explosion. The glass was not even broken, nor was the gauge in any way internally deranged. All testimony showed that there had been but 40 pounds pressure on the boiler, but the engine had tremendous power. Upon examining the gauge, it appeared that somebody's curiosity had been aroused. Like Helen's babies, he "wanted to see the wheels go round," and had taken off the glass and turned the finger around the dial once and left it in front of the pin. The parties were honest in their belief that 40 pounds pressure had exploded the boiler; but, upon testing the gauge, it took 320 pounds to move the hand to the point at which the boiler gave way.

One more point. We will continue to have explosions as long as large corporations, users of boilers and makers of boiler plates, can afford to send men throughout the country with petitions to be signed to present to legislatures, to prevent all legislation on the matter that will protect the lives of their employes. Such is the case in Ohio, and the only excuse offered was that it subjected such corporations to thousands of dollars of expense. Let us have some such laws as exist in France and Belgium, and no doubt the percentage of boiler explosions will be greatly diminished.

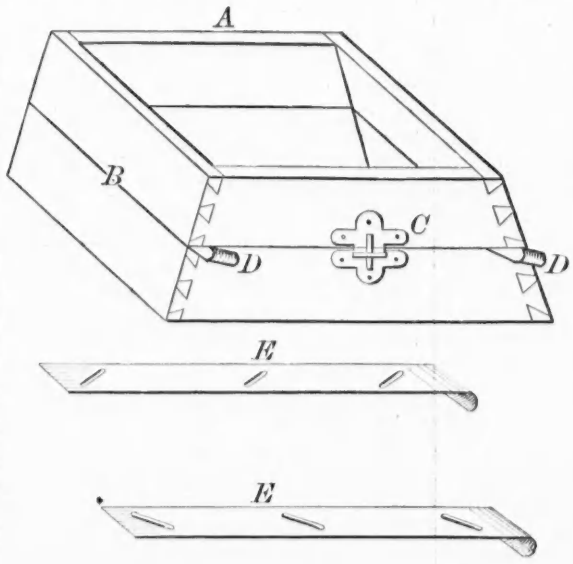
The writer was once engaged in the manufacture of engines and boilers, but is not at present, and these few points given, whether of value or not, come from no selfish motive.

Canton, Ohio. C. M. MILLER.

Building up Wooden Rolls—Chordal's Pulley Scheme—Allowance for Finishing Cast Iron.

Editor American Machinist:

Having occasion recently to build up a number of wooden rolls on cast iron heads, and being pressed for time, it occurred to me to utilize the circular saw in hollowing out the staves to fit the circular heads. This I accomplished by placing a temporary gauge diagonally across the saw table at an angle of about 40, and securing each end to the saw table with a hand clamp. I then lowered the saw to the proper depth, and proceeded to hollow out the staves, using the diagonal gauge to guide the stuff over the saw. With a twelve-inch saw and a gauge at a suitable angle, I found that I could produce staves that would fit a nine-inch circle very nicely, and in a mere fraction of the time that it would take to do them in the ordinary way. I do not claim originality for this "kink" (although I had not previously seen it practiced), nor do I expect to startle many of the old chips by its novelty. But I thought perhaps it might be useful to some of the "boys"—those who have not yet learned it all, and who are willing to profit by the experiences of others.



Not being one of the refined few, but rather one of the ignorant multitude, I will, of course, be pardoned if I take this opportunity to express my admiration of Chordal's pulley scheme, and to venture the hope that he may some time find an opportunity to tackle another problem that sorely tries the patience and vexes the soul of the pattern-maker. I refer to the uncertain, ever changing, unsolved question of the amount necessary to allow for finish on work to be planed or turned. Some machinists require an eighth of an inch, others get along on a tenth, while there are others who are satisfied with a sixteenth of an inch—all on the same class of work. To complicate matters still more, these same machinists will probably require in the course of a week all these different allowances for finish on the same kinds of work. Unreasonable as this may appear, they are outdone by the fellow who wants his work to go together without recourse to either planer, lathe, or file, and expects every piece to *fit*, and who blesses the pattern-maker if they don't fit. SANDPAPER.

Pounding in Steam Engines.

Editor American Machinist:

In your issue of August 13, and in answer to C. G. B., of Fremont, Ohio, I notice that you enumerate certain of the causes of "pounding" in a steam engine. Didn't you omit to mention that one of the chief causes of that disorder is the employment of an incompetent engineer ?

BLACKMASH.

New Form of Flask.

Editor American Machinist:

Will you please allow me, through your columns, to give to the moulding branch of the craft a (to me) new form of flask, given me by one of the moulding fraternity. It is designed to take the place of the old time-honored snap flask, and is shown by the accompanying engravings. It is simply a flask *A*, made with suitable draft, so that it will readily lift off from the board after ramming up, and leave the mould in good shape. The flask should be dovetailed together the full height, or rather depth, then sawed in two at center *B*. The smaller half or cope *C* should have fitted to its lower edges, on two sides, a strip of hoop iron *D D*, ¾″ wider than the thickness of the flask. These strips should have three slots in each, ¼″ wide, with ¾″ lead, made right and left, as shown at *E E*; so that when they are pushed in at one end of throw the strips will project ¾″ inside of the cope.

This will enable the moulder to lift off the rammed up cope from the nowel, to remove the pattern. When he replaces the cope, and draws out the strip again to the other end of the throw, by means of a suitable scroll turned up on the end of the strips, the whole flask can readily be lifted up clear from the mould.

This saves all locking and unlocking, and enables the moulder to put up fully one-quarter more work. I. B. C.

Elmira, N. Y.

It is stated that no silver mine that has ever been worked, has been entirely exhausted, but work continues in some form.

Method of Arranging and Indexing Drawings and Plans.

By ALBERT F. HALL.

A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Any time which the engineer devotes to perfecting the arrangement and indexing of his drawings will be amply repaid by the time and trouble it will eventually save him; and if the writer of this article is able to assist, even to a slight degree, his professional associates in attaining this desirable object, his efforts will be fully rewarded.

In what follows, it will be the aim to point out how to proceed when indexing a new set of drawings, and also how to remodel a collection arranged in the ordinary manner to conform to what the writer considers a more convenient system.

For the sake of uniformity and ease in handling, the writer has made all of his drawings on either full, half or quarter sheets of Whatman's "double elephant," and has arranged them in drawers of corresponding sizes and about two inches in depth. Each drawer is provided with a peculiar handle, having a pocket for a removable label. The drawings are all numbered on each of the four corners, the numbers on the left hand end being upside down, so that they may easily be read should the drawing have been turned around in the drawer. Every drawer is labeled with a number corresponding to the drawing bearing the lowest number in that drawer. To avoid confusion, no two drawings have the same number simply, letters being used in connection with the numbers, as we shall see later. The index and references always tell on which of the three sizes the drawing is made, and consequently in what set of drawers it will be found. To illustrate: Let us take the drawing of an engine 9″ × 16″ made on a full sheet and numbered 45. The index card referring to this engine will have "Drawing full sheet, 45," which tells at once the set of drawers, and the position in those drawers, in which it must be sought. On the main drawing of the engine together, or upon a sheet referred to on that drawing, will be found references to the various details used in its construction, thus: Steam cylinder, ½ sheet, 45—A; steam piston, ½ sheet 45—B; cross head, ¼ sheet, 45—C, etc. It may of course happen that parts which have been used for other engines are also to be used for this. Then we shall have something like the following: Connecting rod, ½ sheet, 36—B; stuffing box, ¼ sheet, 27—M, etc. Each of these details will always have a reference to the machine for which it was first made. Where there are many parts of a kind and size, but varying in design or arrangement, it is well to group them and give them all the same number but different letters. By so doing we can easily compare them, and see at a glance what has been done and whether any of them can be utilized in a machine in process of construction. Suppose, for instance, the drawing to be of a 12″ steam piston, and this drawing to be ½ sheet 46; now all other 12″ steam pistons would have this same number with various letters, and would preferably be on sheets of uniform size. The index cards (reduced in size) for such would be thus:

12″ Steam Pistons.

½ sheet 46.
A do. 46.
B do. 46.

The card not only tells the drawings but the letters already used, and thus prevents repeating a letter. When all the letters of the alphabet have been used, a new number may be taken and another group be formed, though the letters may be doubled. Such groups are very useful, as they are soon learned, and reference to the index often becomes unnecessary. Whenever a pattern is to be changed, a new drawing should be made and the change carefully indicated, reference being given to the original drawing, which drawing should also have a note stating the changes that have been made and where these changes are to be found. Even if such changes are to be permanent, the original drawing should not be erased, as it is oftentimes necessary and important to preserve the record, and it is better to make a new drawing.

All drawings should be indexed on cards of uniform size, about the size of a postal card, and arranged by titles in alphabetical order; cards of different letters being separated by thin strips of pine wood, or by a zinc plate of the size of the card. This plate should have one edge bent so as to form a lip which projects sufficiently for writing the divisions. Where there is a group of details, such as steam pistons, a slip with the title, "steam pistons," may be inserted, and the sizes arranged in numerical order in this division. On many of these cards little descriptions are written and sketches sometimes added, giving the principal parts so as to avoid, oftentimes, reference to the drawing.

The tracings are kept in a duplicate set of drawers for the use of the workmen.

Having now described the manner of arranging and indexing the drawings, it remains to show the method adopted for keeping a record of the patterns.

Every pattern has a number, which is given on the drawing; the main piece having the simple number, and all loose pieces and parts belonging to this bearing the same number with the addition of various letters. Thus the patterns for the 12″ steam piston would be numbered somewhat as follows: Head pattern, 98; follower pattern, 98—A; ring pattern, 98—B, etc. Card indexes are arranged, giving the various pattern numbers, and referring to a book wherein a description and other particulars of these patterns are given. These cards are made as follows, and are arranged in numerical order in a drawer, each group of one hundred being separated by a wood slip or zinc plate as described above:

98

98—½ sheet 46.
A do. 46.
B do. 46.
Pat. book, p. 510.
C ½ sheet 46—A.
D ½ sheet 46—B.
Pat. book, p. 7.

These cards also show the letters that have been used in connection with any number. Should a piece be misplaced in the foundry, it can be traced by the number which is stamped upon it, to the index, and by that to the drawing and pattern book. In ordering castings, the parts which are wanted can be designated by the number and letter. In addition to the above, each pattern maker receives a printed slip, a sample of which, reduced in size, is here appended, to be filled out and handed by the foreman to the draughting room, on the completion of the pattern, to be recorded in the book alluded to, the heading of a leaf from which accompanies this article.

Pattern,	98.
Drawing,	½ sheet 46.
Date when finished,	July 28, 1881.
Material,	Pine.
Hours' Labor,	

An experience of about nine years has shown the practical value of this system to the workmen and all others who have occasion to consult the drawings; it is much superior to the ordinary method of cataloguing in a book, as it permits of a systematic arrangement, impossible in a book, unless no more drawings are to be added to the collection.

The great advantage of uniformity in the sizes should not be overlooked, for where the drawings vary in size, the smaller sheets are liable to slip under the larger, and thus escape notice. Some have observed that their drawings vary so much in character that they cannot be classified, yet all must have titles, and can easily be alphabetically arranged by these titles. Again, others say they have so few drawings that it will not pay. To such the answer is, who knows how rapidly the drawings will accumulate, and reach a state of chaotic confusion? The writer was fortunate enough to commence with this system, and time has shown him its incalculable value, his collection having grown to about 3,000 drawings.

No of Pattern.	Drawing.	Date when finished.	Material.	Cost of Material		Hours Labor	Total Cost	Descrip'n and for what used
				Per foot.	Total.			
98	½ sheet 46	July 28, 1881	Pine					Head of 12″ piston.
91 A	" "	" 29, 1881	Pine					Follower of do.
" B	" "	" 30, 1881	Pine					Rings of do.

It will now be shown how a collection, consisting of over 3,000 drawings, was remodeled from an imperfect system.

A book was printed, containing, on the left hand of each page, two columns, one with the heading "Old Numbers," and the other with the heading, "New Numbers," the remaining space being left for "Remarks." The column "Old Numbers" was printed with numbers in numerical order from one upwards, these numbers being arranged in groups of five, for ease in finding, thus:

Old Numbers.	New Numbers.	Remarks.
1	½ sheet 78	
2	¼ sheet 89 *B*	
3	Full sheet 13	
4	½ sheet 74 *D*	
5	¼ sheet 83	
6		
7		
8		
9		
10		

The drawings were then taken as they came along, renumbered, lettered and arranged in sizes to conform, as far as possible, to full, half and quarter sheets of "double elephant." As fast as the drawings were renumbered and lettered, their new numbers were entered in the column "New Numbers," opposite their corresponding old numbers, to be found in the column "Old Numbers." The arranging, grouping and indexing were carried on as the drawings were renumbered, in order not to mix them up, thus avoiding confusion, and enabling the draughtsman and others to use the index as the work progressed. Since this has been done, all are very much pleased, and wonder how they managed so long without it, saving, as it does, all confusion and trouble.

Economy of Fuel.

By WILLIAM J. WILLIAMS.

The perfect combustion of fuel is a matter of great interest, and any means tending to that end will have a national value. While the steam engine of the present exceeds in economy that of the past, and while steam boilers are made in our day which will evaporate more water per pound of coal than was thought possible a generation ago, neither result can be attributed to the superior manner in which the coal itself is burned. Whether we go into a steam boiler fire room that was constructed twenty years ago, or one where the whole plant is only a few weeks old, precisely the same means for burning the coal will be found. Once in a while some one who claims that he has solved the problem of how to produce perfect combustion makes his appearance, and claims that a trial only is necessary to convince the most skeptical. The economizing of fuel has been a problem, which some of the most intelligent men of the world have grappled with in the most earnest manner during the last fifty years, and with varying success. The chemistry of combustion, received and accepted as a truth, seems a very simple matter, but when reduced to practice, is found to be one of the most difficult of problems. Perfect combustion in furnaces used in the arts, or for mechanical purposes, according to the views of those of known intelligence and recognized as authorities the world over, has never yet been accomplished; nor, for various causes, can we avail ourselves of the whole of the heat produced from a given quantity of any kind of fuel.

Coals from different localities vary in their component parts. Taking, for the convenience of illustration, anthracite coal: the average quantity of fixed carbon from ten collieries in Schuylkill County, Penna., is 85 per cent., and that of sulphur one-fourth of one per cent., hydrogen not being present in any of them. If it be assumed that 100 lbs. of anthracite coal contains 85 lbs. of fixed carbon, it would require 332.88 lbs. of oxygen for its conversion into carbonic acid, thereby effecting perfect combustion. Now 332.88 lbs. of oxygen equals 2943.11 cubic feet, to furnish which 1027.70 lbs., or 13424.5 cubic feet of atmospheric air will be required. Sulphur being present, demands its equivalent of oxygen, and small as the quantity is, it requires a further supply of air, if only to become sulphurous acid, and if it remains only as such, is an extinguisher of combustion, while its presence in any form tends to help defeat the object aimed at. Omitting the sulphur from the calculation, the product will be 2943.11 cubic feet carbonic gas, and 10481.39 cubic feet of uncombined nitrogen; that is, if we had an absolutely pure, unadulterated, dry atmosphere, something which never exists; consequently, some idea of the magnitude of the task of accomplishing perfect combustion may be arrived at.

We thus see that each pound of coal requires 138 cubic feet of air for its perfect combustion; that is, to convert the carbon into carbonic acid. Just in proportion as the quantity is deficient is combustion imperfect, while a surplus quantity is a change of evils, since all the air, which passes through a fire without giving up its oxygen to the fuel, will abstract heat and give nothing in return. In all likelihood, in practice, twice the quantity passes through the fuel which chemistry tells us is needed for combustion. Could we isolate each piece of fuel in such a manner that the whole of its surface would be surrounded by the incoming air through the grate, we might be able to come nearer the law of chemical affinity, but there are practical difficulties in the way of this; nevertheless, there is room for improvement over what might be called the rule of thumb practice universally in use.

The question resolves itself into this: *How*, *where*, and *when*, shall air be admitted to the fuel to get the best possible results?

Since the advent of the steam engine hundreds of devices have been used for the more perfect combustion of fuel, and there probably never was one of them that was of general application. To burn fuel a grate is necessary, and it must possess, first: the greatest possible amount of open space per square foot for the ingress of air to the fuel; second, it must have lasting qualities; third, and not least, it shall require as little manual labor as possible to clean and make a fresh fire as often as necessary. It is here that combustion is made to begin by placing on the grate the kindling wood or other like matter, the carbon of which unites at a comparatively low heat with the oxygen of the air, and creates sufficient heat to cause the carbon of the coal to unite, also, with the oxygen of the air. The ability to pass air through the fire depends on the temperature and height of the column of air in the chimney, but from the time that the coal begins to burn, leaving its ash on the grate, the passage of the air through the fuel is being obstructed, until, finally, a sufficient quantity cannot enter to the coal or carbon to convert it into heat fast enough, when the removal of the obstruction (the ash) becomes an imperative necessity. But, is not this the place to admit and control the air, according to requirement? It is here that the new condition of the fuel begins. What other place seems so propitious to admit at will an equivalent of oxygen to its affinitive (carbon) as here? But to control the supply it is evi-

dent that some other means than the chimney must be resorted to. Its power to draw air through the grate depends on the intensity of the heat, which can be created or made to pass into it.

Aside from the expense consequent from such an operation, were it practicable to do so at pleasure, there are other considerations over which there is no control. Barometric changes of the atmosphere are often of sufficient account to baffle the best efforts to even maintain the ordinary conditions of the burning fuel. To supply air at will mechanical means must evidently be resorted to.

So far as I am aware, no systematic attempt has ever been made to use compressed air under the steam boiler, except for the purpose of burning low class fuels. Where employed for this purpose its use is accompanied by an extra amount of heat, when heat is not wanted or desirable, and to the attendant dirt and discomfort. In a successful application of compressed air through the fuel, the chimney would become merely a means to convey away the spent products of combustion. Whatever the mechanical means adopted, they should be under perfect control as to quantity of air to be furnished.

Among the devices for more perfect combustion was the admission of steam through perforated pipes into the ash pit, the claim for this arrangement being a saving of fuel, to an extent that was of itself sufficient to suggest doubt of its utility to any reasoning mind. Thirty per cent. gains are readily guaranteed with devices for this purpose, when half of this amount only is admissible for imperfect combustion in any well regulated establishment. From personal experience of the admission of steam underneath the grate, the conclusion arrived at was that its presence rendered the clinker more porous, and, consequently, the ingress of air through it more ready than if it were in a more compact condition, making it possible to run a fire a little longer before cleaning. The extra amount of air that passed through the sponge-like cinder added a certain amount of oxygen to the fuel, and to this extent it assisted combustion. As a fuel economizer its usefulness ended there and then.

Another device is to carry a thin fire on the back end of the grate, so that a certain amount of air shall enter next the bridge wall, and so mix with the supposed escaping gases, which are deficient in oxygen. I have never known of any extraordinary results being attained from this arrangement. It is certainly very easy to overstep the mark, and thereby defeat the object aimed at. Personal experience has taught me that an evenly thick fire all over the grate produces the best results. Whether there shall be much or little fuel on the grate at a time, or, in other words, a thick or a thin fire, depends on circumstances. If there is to be a short, sharp draught of steam required of the boiler, then a sufficient quantity of fuel should be placed on the grate, if possible to last during the requirement, and should be placed there previous to the demand, and held in readiness. But if the demand be a continuous one, nearly or quite up to the boiler's capacity, then the thickness of the fire must be regulated according to the size of the coal used, whether it is hard or comparatively soft, and the strength of the draught of the chimney, and its ability for furnishing air to the fuel.

The less often the furnace doors are opened the more regular will be the supply of steam. If the fire is replenished with fuel oftener than can be avoided, not only does the fresh fuel lower the temperature in the furnace, but the ingoing air through the open doors passes rapidly along and into the flues, lowering the temperature still further as it goes,

Theoretical firing says, a small quantity of fuel at a time; *practice* says, as large a quantity as kind and size of fuel and draught of chimney will admit.

A small quantity of fuel makes a small quantity of heat, and, per contra, a greater quantity of fuel will make a larger quantity of heat. When a boiler has to supply a quantity of steam, which is much less than its capability, then theoretical firing becomes practical. Under such conditions it is possible to supply a small quantity of fuel, applied at the right time, and to maintain a given pressure of steam without moving the damper, for hours. Less fuel will be consumed than if it were supplied in a quantity necessitating the whole opening of the damper to get the larger quantity of fuel in a brisk state of combustion as soon as possible, thereby preventing a lowering of the steam pressure, caused by the larger quantity of fuel cooling off the furnace on its introduction more than the small quantity did. The increased quantity of air, much in excess of chemical requirement for perfect combustion, carries with it much of the heat previously existing and remaining in the flues when light firing was being done.

To admit air above the fuel at ordinary temperatures, and in excess of absolute requirements, is, then, the opposite of what is desirable. Among the devices for this purpose, which are quite common, are registers in furnace doors, but their purpose is not always understood by the attendant. To show how ignorance prevails even in high quarters sometimes, the following will illustrate:

At a certain establishment, the furnace doors of the boilers were furnished with registers. The firemen were instructed by the engineer that after putting coal on the fires, they should open the registers as soon as the furnace doors were closed, and let them remain open until the color of the flame changed from a blue to a reddish white. They should then close the registers. The matter was explained to the men as far as they were able to comprehend the subject. They were told to observe closely and see whether, by using the registers, they could not get their fires up to the greatest heat attainable quicker than if the registers were not used. It did not take them long to believe that they could do so, and as it was a place where every device had to be resorted to that would help to make steam, anything that would do that had a hearty welcome by those who had to do the hard work. During the day one of the firm came into the fire-room, and saw the fireman open the registers after coaling, and asked rather sharply by whose directions he opened them. The attendant said he was told to do so by the engineer, and tried to explain why. In the meantime the engineer made his appearance, and was asked in a not very agreeable manner why he gave such orders. Believing that in one of his employers he had at least a man of fair intelligence, explanations followed, touching just a little on the chemistry of combustion, and the why and wherefore of the use of the register in assisting combustion. The owner said they were not put there for that purpose at all. The engineer asked what they were put there for then. The answer was, "To prevent the fires from burning too fast; for," said he, "I have one in my stove, and when I do not want the fire to burn so fast, I always open it." The proprietor's attention was drawn to the furnace doors of locomotive boilers, also to the hollow stay bolts through their fire boxes, which were quite common at the time. He was invited, the next time he went to a certain railroad, to notice these things, and was asked whether he supposed for one moment that these things were to prevent the fires from burning too fast, when it is an undeniable fact that one of the locomotive builder's greatest difficulties is to make a boiler to supply the engines with sufficient steam. Was it likely that they would do anything that would tend to defeat that object? But it was of no use; convinced he would not be. He directed the fireman to close the registers and to keep them so, but the next day he told the fireman that he might use those registers as he saw fit. It was supposed the owner had either been experimenting with his stove, or had been reading some work on the chemistry of combustion, causing a change of mind, if not of conscience.

The register in furnace doors is seen to be one device for the admission of air above the fire. A judicious use of this arrangement can sometimes be made valuable.

Another device for the same purpose was used more than thirty years ago. Air was admitted through a number of orifices in the sides of the furnace. This device had this advantage over the register, that in passing through the heated walls and red-hot fire-brick lining of the furnace, the air, when it came in contact with the fuel, was at a much higher temperature than it would be in passing through a furnace-door register; consequently, less heat need be abstracted from the fuel to raise the air to a temperature to unite with the liberated carbon of the fuel. But there was no means to regulate the quantity of air admitted. Nevertheless, improvements were noticed where it had a fair trial.

There is this much to be said for it, that the foregoing plan is an inexpensive one. A good quality of fire brick is indispensable; the orifices should be high enough not to become choked from cinder forming against the furnace lining.

The admission of air on, or immediately behind, the bridge wall, has been tried, with various modifications, for many years. In some instances, the air is heated by the waste heat of the flues before its introduction under the boiler, while in other cases it has been admitted without being heated. In some arrangements steam from the boiler is admitted with the air. Although gains have been reported from these arrangements, in certain places where they have been introduced, yet a positive loss has been the result from their application in other places, showing, as before mentioned, that no arrangement yet devised for more perfect combustion under the steam boiler, seems to be applicable in all cases. Nor is this to be wondered at, for in all these devices there is no adequate provision for regulating the quantity of air admitted.

Admission of air without regulation must fail in general adaptation. Success may, to a certain extent, follow in some cases, but, as a general principle, adding to the supply of atmospheric air above or beyond the fire, without some definite knowledge of absolute requirement, is just as likely to defeat the object as to assist it.

The ability to regulate implies a knowledge of the condition of the escaping gases from the burning fuel. Beyond the bridge wall little can be known as to the condition of the gases. If an instrument were devised to show the quality of gases passing underneath the boiler, we should then have some definite knowledge on the subject. Of the fuel on the grate, a practised eye can tell whether it is getting a sufficient supply of air. We have the authority of Mr. John Bourne for the statement: "In all trials it has been proven that the best results have been always attained when all the air has passed through the fire bars." Under the fire bars, then, seems to be the place to admit and regulate the supply of air to the fuel.

If the supply be heated previous to its admission, every degree it is so heated is one degree saved from the fuel in heating it to the combustion point of oxygen with the carbon of the fuel. As to what extent it may be heated, before it would have a destructive effect on the grate, experiment must determine, since it would not be desirable to increase expenses for repairs. Whatever is done to promote combustion will be a net gain.

There is one way by which the supply of air can be heated to some extent, which would make endurable many a fire room, and, it may be added, engine rooms, also, that are now almost unbearable in even moderately warm weather, viz., by having double walls surrounding the boiler (and where there is much length of flue from boiler to chimney, this also might be built in the same manner), and leaving one end of the air chamber thus formed, open to the atmosphere, and the other opening into each side of the ash pit. The front should be closed by tightly-fitting doors, which need to be opened only when cleaning out the ashes that may have fallen through the grate in cleaning the fire. In the present practice of boiler setting, no use is made of the heat thus utilized, it being allowed to escape into places where it is not desirable or wanted. Its debilitating influence is prostrating in the extreme, and there is no good reason why it should not be made to do some useful work.

As to the form of steam boilers to be employed, there is a tendency to use such forms as will occupy the least space and give the power required. Not only does this apply to cities, but also in country places is there a desire to get away from old and cumbrous forms, making the matter of combustion the prominent feature. Where large or long boilers are in use, rapid combustion is unnecessary; but when short and compact forms are adopted (as, for instance, any of the various forms of tubulars now in use and coming into use), rapid combustion becomes a necessity. To create this, a swift supply of air through the fuel must be provided. The present mode of doing this, is by *sucking* this supply through the fuel, the power of doing it being dependent on the lightness of the column of gases in the chimney. The ability to stimulate the draft depends on the rate of combustion in the furnace. This is never fully controllable, without independent means of quickening combustion when most needed. At no time is quickened combustion more needed than after putting on a new supply of coal, when the energy languishes from the very cause which rendered a stimulus desirable.

This lack of sufficiently rapid or stimulated combustion is particularly noticeable and exceedingly undesirable when boilers are worked quite up to or near their capacity. After a fresh addition of fuel on a grate that already contains so large a quantity of ash as to materially affect the passage of air through it, cleaning the grate to facilitate the free passage of air, is impracticable. Practical observation points very strongly towards some means of forcing air through the obstruction, thereby promoting combustion until a feasible time arrives for making fresh fires.

Writers on combustion are a unit in regard to the double quantity of air, which, it is believed, actually passes through a fuel, resulting only in imperfect combustion after all. Accepting their statements as a fact, does it not seem strange that most of those who attempt to improve combustion by special devices, begin, if they do not end, by admitting more air, the additional quantity admitted remaining unknown? It is quite possible that, instead of having admitted through the grate a quantity double the amount required to convert all the carboniferous part of the fuel into carbonic acid gas, quadruple the quantity passes through the flues. The excess of oxygen can have no other effect than to absorb heat, pass into the chimney, and escape into the air. As to the nitrogen which entered with it, its neutrality is open to doubt, since it enters into a place where one of the conditions needed to effect a chemical change is present, viz., heat. Nitrogen is a diluter of oxygen, and, possibly, is capable of extracting and taking with it a certain amount of caloric.

The writer had some experience with a device for more perfect combustion, which did not require an additional supply of air. It consisted of an arch of fire brick, built over the grate. One end of the arch was joined to what would have been the bridge wall, the other end resting against the front. Through the arch were a number of orifices, through which the carbonic acid gas escaped underneath the boiler. By this arrangement the whole of the carboniferous portion of the fuel was supposed to be converted into the aforesaid gas within the oven-like arrangement. The heat, that could be generated within, was intense, being almost a white heat. No experiment was ever tried to ascertain whether there was a gain or not. The plan had its drawbacks, and may have had its advantages, as a promoter of combustion. Until the arch was heated to almost a white heat, there was little effect on the boiler, and it required considerable fuel and time to bring it to that state from starting a fire. Every time fresh fuel was placed on the grate, aided by the flow of air through it, the temperature would be considerably lowered, forming a very good exponent of what takes place in the flues of a steam boiler every time the fires are replenished with fuel.

However complete any arrangement may be for the attainment of perfect combustion, unless judicious means are employed for applying the heat, the best efforts may be made nugatory. The proper setting of a boiler is as important as the boiler itself. Co-operation between owners and builders of steam boilers would do much towards attaining the best possible results, as there is little reliable information of every-day practice and results in regard to the steam boiler and its fuel. There is one point that should not be forgotten by those who attempt to improve combustion by means of any system, and that is, the fireman possesses more control over the action of the fire than any additional apparatus that was ever devised.

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Adornment of Shops and Grounds.

The idea that there is any essential connection between dirt and dividends, or squalor and success, in the manufacturing business, is one which cannot be sustained. If a man were to embark in any new business, and were foolish enough to spend all his time and means in beautifying the house and grounds in which he lived, nobody would think his business chances worth talking about. But because a man is investing time and money in business, of whatever nature, it does not follow that he should not find both time and means to give his house an occasional coat of paint outside, or cleaning inside, to have grass plots and flower beds and pleasant shrubbery enough in his yard to make the place look like home, or be worth living in. The man who should show such a complete want of appreciation of home comforts, as would be implied by systematic neglect of the place that stood to him in the place of home, would show, indeed, such want of perception as would inevitably, among sensible people, cast a slur upon his business qualities.

Yet this is exactly what thousands of employers of labor are constantly doing with the place that is the home of their business, and that is their home, and that of their employes, during nearly half of each day, week, month and year. There are a good many manufacturers who, in putting up buildings, seem to start out with the intention to make them look as ugly and cheerless as possible. They would not have the place one on which the eye could rest with pleasure, on any account. That an employe should ever feel a pride in the appearance of the establishment would seem to them like a perversion of all reasonable uses. That good taste and pride in a neat appearance among workmen have their economic aspect such a man could never be driven to admit. That the workman who likes to see his family trim and comfortable, and is thoughtful enough for their comfort and his own to encourage the little adornments of home which mean so much and cost so little, is likely to prove a better workman than his shiftless neighbor, seldom enters such an employer's mind. That such men are likely to be attracted to and retained in a manufacturing establishment by evidence that their feelings are understood and their comfort looked after, is a consideration that even such employers should take time to consider. That more work and better work will be done by contented and appreciative mechanics, who have a soul above the tools they work with, is a conclusion that even such an employer may fairly hope to come to in time, if he will give it a little study. That habits of neatness and tidiness, so far as methods of doing work are concerned, are likely to be promoted among even careless workmen, by contact with tasteful surroundings, would seem to follow almost of course as a matter of analogy.

Let employers, then, who want to see the right kind of work done by the right kind of workmen, consider whether neatness in the construction and arrangement of the shop, an occasional flower pot in an occasional window, when practicable, and a little green grass and a few flower beds in the immediate neighborhood of the shop, may not, in the long run, prove themselves to have a commercial, as well as a sentimental value.

A Peculiar Property of Matter.

A great deal has been written concerning the physical properties of matter, and it would seem, that so far as our knowledge extends, the subject was well nigh exhausted. Strange as it may appear, there is one property of the most common substance, with which the machinist has to do, that has never been accounted for, or in any way alluded to, in works on this subject. We refer to that peculiar property of cast iron, by virtue of which, when in the condition of old cylinders, pieces of pipe, safety valves, and a multitude of other forms, it manages to get exactly in the way of every man in a good sized machine shop, and at about the same time. Practical men know this to be a fact, and are looking to science for an explanation. It has long been reasonably well established, that in a shop where the custom is to preserve such things, notwithstanding they may be relegated to some particular corner devoted to their preservation, they will find a way to get themselves distributed all over the shop without any very serious delay. It would be a valuable acquisition to our present knowledge to know why this is so. While carrying on the investigation necessary to determine what particular property enables inert matter to get away with the best intentions of proprietors, foremen and workmen, it might be well to conduct it with a view to finding out what property could be added to cast iron, so that it would be possible to get useless scrap from the machine shop and into the cupola.

There is a broad field here for scientific investigation, and in a direction where there can be no possible clashing of theory and practice; the latter having virtually withdrawn from the contest.

As the night traveler in the neighborhood of a great city knows by the luminous quality of the heavens in a certain direction that that way the city lies, though no single light or roof or spire can be seen, so the seeker after mechanical truth sees outlined against the atmosphere of each day's progress the effect, not of a few men's attainments, but the result of the work of myriads of toilers. No hand is so hard or so humble, that it cannot hold a torch in aid of that great illumination.

Drawbacks to Perfection.

In view of the fact that every parent firmly regards his or her new-born child as the best and brightest child that ever lived, a celebrated novelist once observed that the world must, of necessity, be improving at a rate almost inconceivably swift. With the children of each generation so superior in mental qualities to those exhibited by the preceding generation, the date when absolute perfection will be reached cannot be far distant.

In these days of inventive skill and application no one can have failed to notice that almost every new invention, whether it be machine or process, is infinitely (or at least a good deal) better than any previous invention for the purpose. (The inventor usually considers it as "infinitely better," but the general public may more safely assume a less rapid rate of progress.) On this view, the date at which nature will be bankrupt, and have no more secrets to offer us, must soon be matter for speculation, if not for mathematical calculation. There is one saving clause, however, that lies between us and all this perfection, and that is, the important department of science which lies wholly within the domain of personal skill and manipulation. Fortunately, this must be acquired, and can only be acquired slowly. As an eminent surgeon recently remarked: "Science dies with each generation," and this fact is doubtless one of the wise barriers which nature has set up to prevent her own annihilation. Were absolute perfection really reached, a descent more or less rapid toward barbarism would have to follow, as a matter of course. The race could no longer go forward, and would begin to go backward. Idle machinery always rusts. Let us be thankful that although we are not improving as rapidly as we sometimes think, we are still improving.

A Good Suggestion.

At one of the Altoona sessions of the American Society of Mechanical Engineers, a question was asked in regard to the consumption of coal per horse power per hour upon locomotives, but none of the persons present were able to furnish the desired information. It was proposed that a committee be appointed to make the necessary tests to ascertain the average weight of coal consumed per horse power per hour upon locomotives. Such a committee was not appointed, however, but it is expected that something will be done in this direction at the next meeting.

We believe that if such a committee were appointed to make tests, that the information thus obtained would be reliable and carry weight with it, from the fact that it would be obtained by men who are thoroughly competent, and whose business it is to test engines. The data thus obtained would be of great value to railroad companies, as well as to the engineering profession generally, who now know so little respecting the actual coal consumed by locomotives in developing a horse power.

This is a move in the right direction. If the Society had an efficient committee on experiment, it would repay the members largely by the fund of reliable practical information obtained in experiments. This should be a standing committee, so that when complicated subjects arise they may be referred to it to dispose of, either by experiment or in any way that may seem to promise the most valuable results. The Society will, at the rate at which it is now progressing, soon have sufficient means at its disposal to carry on a system of investigation which, when completed, may be presented to the world in a practical and reliable manner.

Many experiments which have been tried heretofore have been shrouded in mystery when the subjects were apparently very plain. What is wanted at the present time is a more practical method of working up tests and experiments.

The Negro as an Iron-Worker.

In a recent issue, an esteemed contemporary broached an interesting question, viz., The Negro as an Iron-Worker, with special reference to the Southern portion of our country. We think the expectations of our contemporary regarding the negro's attitude toward trades union matters will bear revision. What is known of the social characteristics of the negro leads us to believe that any given number of negroes are quite as likely as their white compatriots to be led into trades unions, and that, once being in, they are a good deal more likely than the same number of white trades unionists to play the game of "follow my leader" in the way of strikes.

The greater ability of negroes to withstand the extreme temperatures incident to iron-making in the South, as compared with that of white iron-workers, is, perhaps, an open question.

A Profitable Meeting.

The day following the meeting of the Mechanical Engineers at Altoona, the guests and callers at the hotels were put to their wits' end to understand the meaning of the figures and hieroglyphics drawn with lead pencils upon the newspapers, pamphlets, seats and board fences. In fact, every smooth surface that did not escape the eyes of the engineers was ornamented with a diagram representing some part of machinery, or illustrating some mechanical problem. Many of these figures were as mysterious as any of the designs upon the obelisk or Egyptian tombs, but they were well understood by the persons who made them, judging from the rapidity with which exchanged ideas were jotted down in note books.

There were more notes taken at the Altoona meeting than on any previous occasion, and we heard the remark several times repeated by different members: "I have learned enough since I came here to repay me well for coming." We hope this may be said of every meeting of this young and ambitious society.

Testing Steam Engine Governors.

Now that it is drawing near the time for the Fall fairs to open, we hope that some one has considered the feasibility of having a steam engine governor test. This is something which is very much needed, for, in these days of high speed engines, it is of the greatest importance that a uniform speed be maintained. It would be interesting indeed,

to know whether the extravagant claims made by some of the manufacturers of steam engine governors can be maintained in actual practice. This is no more important, however, than tests of other machinery, of which little is known at present, except what the manufacturers claim for their specialties. A little more ambition is required in the line of practical investigation, that we may know definitely what a piece of machinery is doing, and what is the cost of doing it

Italian Enterprise.

While the people of other countries are striving for the South American trade, the colonists from Italy seem to be settling the matter in a quiet way, and with the advantage of being on the ground. It is said that fully one-half of the population of Buenos Ayres are Italians, and the excellence of their productions, as exhibited by them at an industrial exposition recently held in that city, is the subject of considerable comment. The exhibit embraced nearly everything usually seen at such expositions. The Italian people have usually been regarded as deficient in industrial enterprise as compared with most other nations. The considerable number of subscriptions which come in from Italy to the AMERICAN MACHINIST, and the influential quarters from which they come, bear witness to the fact that Italy is waking up to the consideration of industrial possibilities.

Some of Our Topics This Week.

With this issue, Chordal comes to the fore again with his admirable series of "Apprentice Papers," paying special attention to the occult power that makes the wheels go round. Mr. Lyne contributes a shop kink that one of the leading railroads in the country is about to adopt for use upon all the planers in their shops.

A practical method of casting large pipes in green sand is offered to the foundry fraternity by Thomas D. West, which will be found a valuable contribution.

The chairman of the committee which recently reported to the Master Car Builders' Association, on standards for screw threads, himself the general master car builder of an important railroad, answers a query relating to the report of that committee, as published in our July 2nd issue.

A stalwart "Apprentice" gives some views on the "Ideal Engine," in our department of Letters from Practical Men, which are worthy of consideration by older heads. An Ohio correspondent tells us something about safety plugs that will fuse, as an element of boiler practice. We should be glad if he would add to the practical value of this contribution by describing the mixture of metal used in these plugs, that our readers may more nearly get the benefit of the numerous trials which he has made. A new form of flask is also offered to moulders, by another practical correspondent. Our esteemed contributor, Wm. J. Williams, from whom our readers have not heard for some time past, presents some thoughts on the great question of economy in the industrial use of fuel.

QUESTIONS & ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

If I. C. W., Parkersburg, W.Va., will give his name in full we will reply to his questions.

(1) G. L. D., New York, asks: 1. Is there any rule for determining what pressure you can obtain from a screw and lever, such as is used in some shops for pressing on wheels and similar articles? *A.* You can solve such problems by simple proportion. Example: What will be the pressure exerted by a screw of ½" pitch, the power applied at the end of a 5 foot lever being 100 lbs.? The end of the 5 foot lever will move a distance of 188.5 inches in making one revolution. At the same time the screw will have traversed .5"; hence

.5 : 188.5 :: 100 : 37700.

That is, 100 pounds applied at the end of a 5 foot lever would, disregarding friction, exert a pressure of 37,700 pounds through a screw of ½" pitch. To put it another way, and perhaps plainer; the end of the lever moves 377 times as fast as the screw moves through the nut, and hence the pressure of the screw will be 377 times as great as the power applied. 2. Is there any easy way to straighten a piece of steel, say 7-16" thick by 2⅜" wide, and 4 feet long; the piece being both twisted and bent? *A.* We do not know of any satisfactory way except to heat and straighten in the ordinary manner. 3. A friend has a cast-iron box 2 feet wide, 2 ft. 6" high, and 3 ft. 6" in depth, and having an arched top. This box is encased with brick, leaving a space to allow the heat to pass all around it. Inside of the box are shelves ½" thick, and extending the whole height of the box, the shelves fitting loosely, and being separated by distance pieces of cast iron 3½" square. This box is heated to a cherry red, and is used for heating glass. After using for a little time, one side of the box begins to bulge out, while the other side remains straight. What is the cause of this? *A.* It is impossible to tell the cause without examining the whole arrangement. As possibly of some use to you in determining the cause, it may be said that a box, as described by you, being heated and allowed to cool, will warp if it is not of uniform section; that is, if some parts of it are thicker than others, or it will warp if any uneven pressures are brought to bear upon it while it is being heated or cooled, or if from any cause whatever, it does not heat and cool evenly. It seems probable that the trouble may be unequal heating and cooling.

(2) J. R., New Orleans, La., asks: 1. What is meant by the "load in pounds per square inch of piston?" *A.* The expression you quote probably refers to the resistance against which the piston moves. For instance, the piston of a pump or a steam engine encounters a resistance due to the work being done, and when this total resistance is expressed in pounds per square inch of the piston, it may be termed "load in pounds per square inch of piston. Example: The total resistance against which a certain piston moves is 1,000 pounds, and the area of the piston is 100". What is the resistance or load per square inch? $\frac{1000}{100}=10$, which is the load per square inch. 2. What point in the stroke of a piston is its velocity the greatest? *A.* We presume you refer to the piston of the ordinary reciprocating steam engine in which, disregarding the effect of connecting rods of different lengths, the velocity is the greatest at mid stroke, where it is 1.5708 times the mean velocity.

(3) R. D. K., Macon, Ga., asks how to make the drilling compound mentioned by Mr. Hemenway in his article, "A Special Boring Bar," in issue of Aug. 13? *A.* Dissolve in a sufficient quantity of warm, *soft* water, 5 lbs. Babbitt's soap, 5 lbs. sal soda, ¼ lb. carbonate ammonia, ¼ lb. refined borax, ¼ sal tartar. When thoroughly dissolved, add sufficient soft water to make a barrel full of the compound.

(4) F. W. S., New York, asks for rule for calculating compound gearing for screw cutting? *A.* See article, "Screw Cutting on the Engine Lathe," by Frank H. Richards, in issue of Aug. 20.

(5) E. S., Monroeville, Ind., asks: Please give me a recipe for a composition of pitch for the roof of a house? *A.* Take 4 pounds resin, 1 pint linseed oil, 2 ounces red lead, and stir in very fine or pulverized sand until a convenient consistency is obtained, and apply it warm to the tarred paper, with which the roof should be previously covered. This cement becomes quite hard, and yet possesses considerable elasticity, besides it is durable and waterproof.

(6) J. W. K., Brooklyn, N. Y., asks: Will you tell me how I can construct a cheap telephone to work, say, half a mile? *A.* Procure two tin cups, the conical shaped, such as are used in mixing lemonades, are probably the best, and remove the bottoms by unsoldering. Soak a bladder in water, and stretch a piece over the bottom of each cup, and tie the same tightly by cord. After their heads are dry, a string may be attached to each bottom, and carried off to any desirable distance. By drawing the cord moderately tight, and not allowing it to come in contact with any solid substance, the voice may be transmitted nearly one mile. For shorter distances this style of telephone answers very well. Brackets may be soldered to the sides of the cups for convenience in attaching the same to some support. In turning a corner two screw eyes should be screwed into the wall, and a piece of very light cord stretched from one to the other, while the cord for supporting the main line should be attached to this cord centrally between the screw eyes, which does not interfere with the transmission of the sound.

BUSINESS SPECIALS.

50 cts. a line for each insertion under this head.

Alden Crushers. Westinghouse Mach. Co., Pittsburgh, Pa.

For Sale.—Second-hand Boilers and Engines. Young & Locke, Titusville, Penna.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N.J.

James W. See, Consulting Engineer, Hamilton, O.

"Paragon" Metallic Piston Rod Packing. See AMERICAN MACHINIST, July 16th, 1881. Write for prices. A. Wilkinson, Manayunk, Philadelphia, Pa.

Special inducements offered to clubs. "Extracts from Chordal's Letters" in book form, now ready. Cloth. 320 pages. Less than 5 copies, $1.50 by mail, each, postpaid. American Machinist Publishing Company, 96 Fulton Street, New York.

A New Treatise on Steam Engineering, Physical Properties of Permanent Gases and of Different Kinds of Vapor. By John W. Nystrom, C. E., 8vo., cloth. Price, $1.50, also A New Treatise on the Elements of Mechanics, Establishing Strict Precision in the Meaning of Dynamical Terms. By John W. Nystrom, C. E., 8vo., cloth, price. $2.00, Mailed by E. & F. N. Spon. 446 Broome St., New York City, on receipt of price.

"Patent Binder" for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address by mail for one dollar. American Machinist Publishing Co., 96 Fulton St., New York.

We can furnish Volume 3 of the AMERICAN MACHINIST, containing the full 52 issues of 1880, neatly bound in cloth, ready to ship by express, for four dollars. Unbound, three dollars. AMERICAN MACHINIST PUBLISHING CO., 69 Fulton Street, New York.

MANUFACTURES.

The Manny Reaper Works have removed to Waukegan, Ill.

Ohio employs 10,248 hands in the manufacture of agricultural implements.

The Studebakers propose to put $100,000 into carshops at Elkhart, Ind.

Penn & Lee are putting up a wagon-spring factory at Syracuse, N. Y.

The citizens of Vicksburg, Mass., have subscribed $200,000 towards a cotton mill.

S. J. Howell has started a job machine shop at 280 Dover Street, Boston.

The Southern Car Works, of Knoxville, Tenn., will soon commence operations with a force of 200 men.

The Marshall Car and Foundry Company, of Marshall, Texas, are making 800 car wheels per month.

The Lowell (Mass.) Machine Shop has a $500,000 order for the machinery of the Hamilton Mill of that city.

The Babcock & Wilcox Company, New York, are building the boilers for the Belcher Sugar Refinery Company of St. Louis.

The E. Horton & Son Company, Windsor Locks, Conn., are making arrangements to double the capacity of their production of chucks.

Sumter, S. C., will have a cotton mill in operation next November. Home enterprise and capital have accomplished it.

The Hinkley Locomotive Works, Boston, have added a large steam riveter, built by the Whittier Machine Co., to their tools.

The J. Barton Smith Company are laying foundations for a new file manufactory at Fourth and Somerset Streets, Philadelphia.

The Judd Manuf'g Co., Wallingford, Conn., are making considerable addition to their brass foundry.

The Gilbert Loom Company, Worcester, Mass., are about to build a new shop in which to carry on their manufacturing.

The McKay sole-sewing machine patent, which has drawn immense royalties from boot and shoe manufacturers, expires during the present month.

The Hartford Engineering Co., Hartford, Conn., expect to exhibit their Medart's Patent Wrought Rim Pulleys at the Atlanta Cotton Exhibition.

Parties at Greenwich, Washington County, N. Y., are constructing canals from the Battenkill, which, when completed, will make available the second largest water power in the State.

Niles Tool Works, Hamilton, Ohio, are working double turn, crowded with orders and running about 300 men. They have recently enlarged their machine shop 40 by 90 feet.

The firm of Richards & Dole, Springfield, Mass., has been dissolved. F. H. Richards continues the business of designing and building machinery tools and special appliances, and J. L. Dole continues the general machine business of the late firm.

The Pratt & Whitney Company, Hartford, Conn., have just completed, on the order of the United States Government, a double-barreled machine gun of forty-two inches caliber for the Navy Department.

The Fitchburg Steam Engine Company, of Fitchburg, Mass., will furnish the power for the electric lights at the Manufacturers and Mechanics Institute in Boston. The company are full of orders for steam engines.

Cramp & Sons, Philadelphia, have launched one of the iron steamships for the Merchants' and Miners' Transportation Company of Baltimore. This ship is to have compound surface condensing engines of 900 horse power.

Maxwell, Silliman & Dunn, Allegheny City, Pa., are manufacturing an anti-friction saddle for boiler fronts, whereby the strain consequent upon the expansion of the boiler when heated is intended to be overcome, preventing the possibility of breaking or moving the front out of place.

The Syracuse *Evening Herald* says that in Cortland, "pay day, the 10th, has become, to a considerable degree, a terror, because in this, as in all manufacturing towns, there is a certain class who invariably indulge in a spree and do more or less damage."

The Co-operative Furniture Co., of Rockford, Ill., was established one year ago with a capital of $25,000. At the first annual meeting, held July 9th, a report was submitted showing that during the past year the company had cleared $15,000, which was gratifying to the stockholders.

The *Boston Journal of Commerce* says: The representatives of the Chinese government, some weeks ago, engaged Mr. A. W. Danforth, of Newburyport Mass., to proceed to China to take charge of the erection and management of a cotton mill at Shanghai, where the commencement is to be made of teaching the Chinese people the practical handling of the cotton fiber, in making goods such as are required by the population there.

Newly Incorporated Companies.

NEW YORK.

The Dittmar Powder Manufacturing Company, New York: Carl Dittmar, Wm. H. Foran and Maria W. Dittmar, corporators; Capital, $100,000. To manufacture and vend high explosives and sporting powder, and all other kinds and qualities of powder.

Rochester and Southern Railroad Company. Directors, John W. Martin, Jerome Keys, Ambrose C. McGlachlin, Jno. N. Beckley, W. T. Simpson, Hiram Davis, Wm. H. Moore, U. A. Williamson, C. W. Wall, Chas. H. Webb, C. H. Green, A. H. Green and David Martin; Capital, $300,000. To construct, maintain and operate a railroad from the City of Rochester, to Hemlock Lake, Livingston County, via the towns of Brighton, Henrietta, Rush, Mendon, Lima and Livonia. Length of road 30 miles.

Lever Motion Sewing Machine Company, New York; Josiah L. Young, A. H. Jocelyn, Orel J. Hadden and James A. Barbour, corporators; Capital, $1,000,000. To manufacture and sell sewing machines, shade rollers, and other articles.

The Continental Conduit Company, Hunter's Point, L. I.; Andrew N. Rankin, Jno. J. Van Buskirk and Franklin Vose, corporators; Capital, $600,000. To manufacture and sell cast iron conduit pipes.

The Salamander Car Axle Company, New York; Jas. W. Tucker, Theo. R. Tunby and Chas. N. Morgan, corporators; Capital, $500,000. To manufacture and sell axles for railroad cars and other vehicles.

The Wheelwright Malt Kiln Company, New York; Robt. L. Fabian, Chas. Wheelwright, Jno. F. Collins, Geo. H. Fitzwilson and J. Thorn Easton, corporators; Capital, $200,000. To construct and operate malt kilns.

The Maxfield Aluminized Rubber Company, New York; Chas. A. Maxfield, C. T. Bowen and J. Bonton Crosby, corporators; Capital, $100,000. To manufacture and sell soles for boots and shoes, and to manufacture material in sheets, cakes, etc., to be used on soles of boots and shoes where anti-slipping material is required.

Willsboro Pulp Company, Limited, Willsboro; Wesley G. Lyon, Walter D. Palmer, E. W. Richardson, and others, corporators; Capital, $40,000. To manufacture and sell wood pulp and its products.

Excelsior Electric Company, New York; Wm. Hochhausen, M. H. Moses, Geo. D. Allen, Moses Ehrenreich and Henry Herman, incorporators; Capital $500,000. To manufacture and sell all kinds of electrical machinery, apparatus and appliances for illuminating purposes.

Powell Steam Motor Company, Limited, Stanfordville, Dutchess Co.; Edgar Knapp, James Sands and Silas O. Rogers, incorporators; Capital, $35,000. To manufacture and sell Powell's Steam Motor, and the various appurtenances and appliances for connecting the same with machinery.

The Celluloid Stereotype Company, New York; Henry B. Barnes, Henry L. Furbox and Edwin B. Horton, incorporators; Capital, $50,000. To manufacture and sell articles made from Celluloid and other plastic materials or metals.

Gelatinized Fibre Company, Brooklyn; Austin Dall, Geo. C. Lawrence and Edward J. Mitchell, incorporators; Capital, $50,000. To manufacture and sell fibrous substances, and articles composed wholly, or in part, of fibrous substances.

Union Wood Preserving Company, New York; Jas. L. Robertson, Dan'l R. Kelly and David K. Hickey, incorporators; Capital, $300,000. To buy and sell timber, and to manufacture the same into lumber, and the various forms and uses for which lumber may be used, and to sell and dispose of the product thereof.

The Sackett Combined Plow and Pulverizer Co., New York; Chas. E. Sackett, Chas. S. Hurd and Alfred J. Manning, incorporators; Capital, $500,000. To manufacture and sell the Sackett Combined Plow and Harrow, and other implements and machines.

Highland Junction Railroad Company. Directors: Edward Kearney, Chas. H. Swan, Daniel Patterson, Jno. H. Mooney, Aug. T. Docharty, Vincent C. King, Theo. F. Hascall, Frederick S. Gibbs, Sidney P. Nichols, Stephen O. Jennings, Peter Bowe, Jno. E. Phelps and Thos. E. Creamer. Capital, $1,000,000. To construct, maintain and operate a railroad, commencing at Matteawan, Dutchess Co.; thence by most feasible route to a point on the Hudson River, below Dutchess Junction, at or near Breakneck Hill; thence by bridge over Hudson River to Butler Hill, Orange Co.; thence to Cornwall Station, on Newburgh Branch of the N. Y., L. E. & W. R. R. Length of road ten miles.

CONNECTICUT.

Winsted Silver Plate Co., W. Winsted; C. J. Cramp, John Woodford, and others, incorporators; Capital, $12,000. To manufacture and deal in plated wares.

The Textile Mfg. Co., Stonington; Geo. Hubbard, Moses Pendleton, and others, incorporators; Capital, $10,000. For the manufacture of textile fabrics.

Machinists' and Engineers' Supplies.

NEW YORK, August 18, 1881.

The condition of the supply market is entirely satisfactory and every dealer is anticipating a brisk Fall trade.

Manufactured brass goods have advanced about 15 per cent. since the beginning of the month.

Machine bolts, nuts and washers, have also advanced about 15 per cent., and are unsettled, with an indication of going still higher.

Sledges, hammers, and forged steel goods, have advanced about 10 per cent.

Iron pipe is hardly obtainable at any reasonable price, and while the price is nominally 65 per cent. discount from list, yet it is very difficult to get supplied at 60 per cent. This fact is owing to the mills all being over sold. Discount on Boiler Tubes 40 per cent. off, and Oil well Casing and Tubing 21c. and 70c. per foot, net.

The Akron Iron Co., Akron, O., have issued their annual catalogue of hot polished shafting. This catalogue, in addition to the usual price list and a telegraph cipher code, contains interesting information relating to the processes of manufacture, quality of stock, strength, etc. This shafting will be supplied cut to length, and key seated, if desired.

The Deane Steam Pump Co., Holyoke, Mass., have established salerooms at 226 and 228 Lake St., and 16 to 22 Franklin St., Chicago, Ill., for the convenience of their western trade.

Macdonald & Hogue are in market with the Hogue Graded Injector, which they are selling from their factory at Sandy Lake, Pa.

The Phenix Manufacturing Co., 107 High St., Newark, N.J., issue a circular of the Phenix Hardening Compound, for hardening steel tools, etc., which is said to show good results and to greatly simplify the working of steel into tools.

Iron and Metal Review.

NEW YORK, August 18, 1881.

The iron trade is active with large sales. We quote same as last week: Foundry No. 1 X, $24.50 to $25; No 2 X Foundry, $22 to $22.50. Grey Forge, $21. Scotch Pig, market active and firm. Eglinton, $21; Cambroe, $22.50; Coltness at $23.50 to $24, Gartsherrie, $23 to $23.50, and Glengarnock, $22.50 to $23. Iron rails active and firm at $48 to $49; steel rails quoted $55 to $58, sales large. No. 1 wrought scrap, $28 to $30. Ingot Copper has slightly advanced, being 16⅝c. to 16¾c. Pig tin still firm. We quote Straits, 21c. to 21⅛c. Lead is firm, Common, 4⅞c. to 5c.; Refined, 5⅛c to 5¼c. Spelter firm, and quotations unchanged, Western, 5c. to 5⅛c.; Silesian, 5¼c. to 5⅜c.; Sheet Zinc, 7c.; Antimony, 14¼c. to 15c.

WANTED

Tool Maker Wanted, must be well recommended and capable of making first-class tools, address with references and price, B., BOX 15, AMERICAN MACHINIST.

We want a man qualified to take charge of Machine Shop and design and build Portable Engines and Mill Machinery. A liberal salary given. Address with experience and references. L. LaRue Smith, Sec., Kansas City, Mo.

Wanted—25 best Knitting Machine Manufacturers. Please send prices, &c., to H. W. Murdock, Montreal, Canada.

Position as Superintendent by a well-known and experienced Machinist and Designer, who is now occupying a similar position. Address, SUPERINTENDENT, AMERICAN MACHINIST Office, Box 14.

Mechanical Draughtsman, 23, just landed, wants situation. Five years experience, three in England. Passed Engineering College. Address Box 2, AMERICAN MACHINIST.

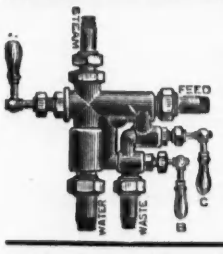
SPECIAL NOTICE.

Parties building all kinds of

Chair, Bobbin, Spool, Shuttle Machinery

will please send descriptions, cuts, prices, to A. W., AMERICAN MACHINIST office.

WATCHMAN'S IMPROVED Time Detector, with Safety Lock Attachment. Patented 1875-6-7 Beware of Infringements. This Instrument is supplied with 12 keys for 12 different stations. Invaluable for all concerns employing night watchmen. Send for circulars to E. IMHAUSER. P. O. Box 2875. 212 Broadway, New York.



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The best Boiler Feeder known. Not liable to get out of order. Will lift water 25 feet. Always delivers water *hot* to the boiler. Will start when it is hot. Will feed water through a heater. Manufactured and for sale by JAMES JENKS, Detroit, Mich.

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are respectfully requestd to reduce as much as possible the amount applied for in order that Exhibitors who have not specified their requirements may not have their applications for space rejected.

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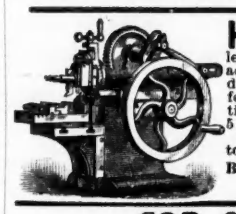

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One 16 x 32 engine, good order, price reasonable Address,

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And all others making and using Steel Tools.

PHŒNIX MANUFACTURING COMPANY,

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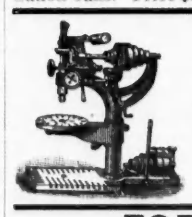
Samples sent free by mail. Put up in Quart and Gallon Cans. Price $1 per Quart; $3.50 per Gallon



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And other Machine Tools for R. R. and Machine Shops

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Also a great variety of small

STEAM ENGINE BOILERS & TOOLS.

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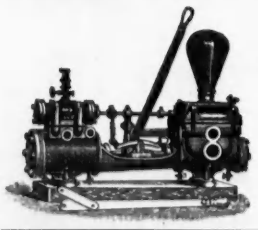

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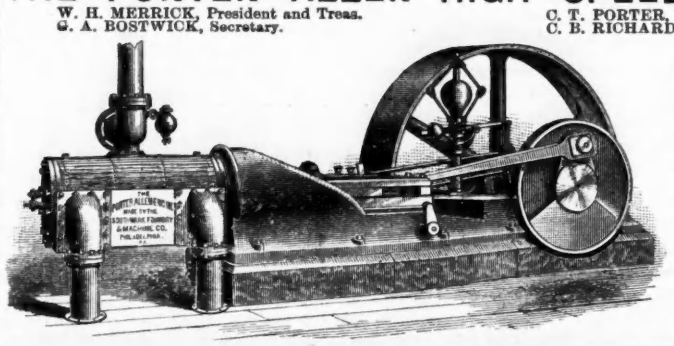
THE PORTER-ALLEN HIGH SPEED ENGINE.

W. H. MERRICK, President and Treas. C. T. PORTER, Vice-President.
C. A. BOSTWICK, Secretary. C. B. RICHARDS, Superintendent.



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Orders solicited for Iron and Brass Castings in the rough.

Address the Company, 430 Washington Avenue, Phila., Pa.

KEARNEY & FOOT

Office, 101 Chambers Street, N. Y. **Full Weight Hand-Cut Files.** Manufactory, PATERSON, N. J.

The best and cheapest in the end. Send for quotations. The files speak for themselves in the following testimonials. Read them.

THE SINGER MANUFACTURING CO.

Messrs. KEARNEY & FOOT, Elizabethport, N. J., July 9th, 1877.

Dear Sirs:—We have for the past ten years used the Files of your manufacture, and during that time we have never had any fault to find with them. We can safely affirm that for evenness of temper, sharpness of cut, accuracy of shape and all other qualities which go to make up a perfect File, they are equal, and in some respects superior, to the best English-made Files. Very Truly, WM. H. INSLEE, Contractor.

Messrs. KEARNEY & FOOT, Elizabethport, N. J., May 3rd, 1877.

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We print on card board 10 x 12 in. "Instructions on the use of Files," which are intended for shop use. These instructions with our "Illustrated Catalogue of Files" we mail on receipt of 27 cents postage To customers we mail a complete set free of charge. **KEARNEY & FOOT.**

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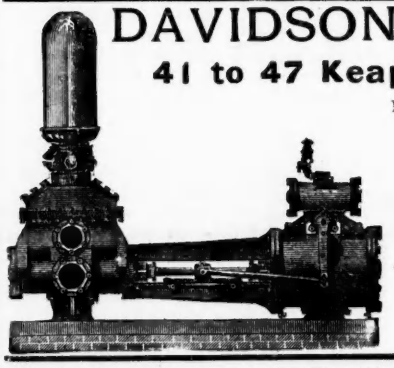

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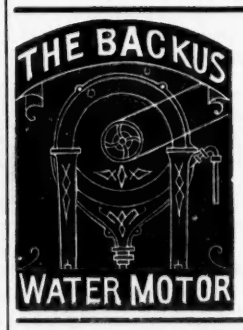

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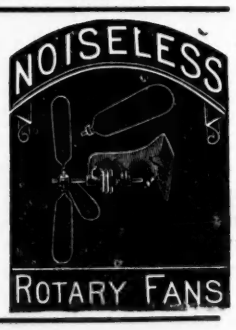

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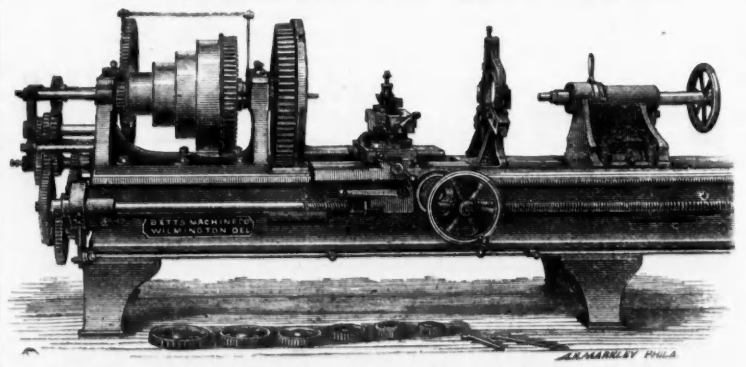

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